

REVISED EDITION

# KENWOOD

# SERVICE MANUAL

## TS-940S

## SP-940, AT-940, SO-1, VS-1

### HF TRANSCEIVER



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## CIRCUIT DESCRIPTION

The equation is arranged as follows.

$$f_{IN} = f_{VCO} - f_{HET} + f_{CAR1} - f_{CAR2} \dots \dots \dots (1)$$

The term  $f_{CAR3}$  is eliminated as it is not related to the receiver frequency itself. As for the remaining terms, all are generated in the PLL (Phase Locked Loop) circuit in the configuration shown in **Fig. 2**. The frequencies generated are now examined for each loop.

In VCO0

$$\frac{f_{VCO0}}{N0} = \frac{1}{2} \cdot f_{STD}$$

$$\therefore f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \dots \dots \dots (2)$$

In VCO1

$$\frac{f_{VCO1}}{N1} = \frac{1}{4} \cdot f_{STD}$$

$$\therefore f_{VCO1} = \frac{N1}{2000} \cdot f_{STD} \dots \dots \dots (3)$$

In VCO2

$$\frac{f_{VCO2} + \frac{f_{VCO4} + f_{VCO5} - f_{VCO1}}{10}}{N2} = \frac{1}{2} \cdot f_{STD}$$

$$\therefore f_{VCO2} = \frac{N2}{1000} \cdot f_{STD} + \frac{f_{VCO1}}{100} - \frac{f_{VCO4}}{10} - \frac{f_{VCO5}}{10} \dots \dots \dots (4)$$

In VCO3

$$\frac{\frac{f_{VCO2}}{10} + f_{STD} + 3 \cdot f_{STD} - f_{VCO3}}{N3} = \frac{1}{2} \cdot f_{STD}$$

$$\therefore f_{VCO3} = \frac{160 - N3}{40} \cdot f_{STD} + \frac{f_{VCO2}}{10} \dots \dots \dots (5)$$

In VCO4

$$\frac{f_{VCO4}}{N4} = \frac{f_{CP}}{1800}$$

$$\therefore f_{VCO4} = \frac{N4}{1800} \cdot f_{CP} \dots \dots \dots (6)$$

In VCO5

$$\frac{f_{VCO5}}{N5} = \frac{f_{VB}}{1800}$$

$$\therefore f_{VCO5} = \frac{N5}{1800} \cdot f_{VB} \dots \dots \dots (7)$$

The above equations are thusly arranged so the frequencies of each local oscillator are expressed as follows.

$$f_{VCO} = \left( \frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000} \right) f_{STD} - \frac{N4}{180000} \cdot f_{CP} - \frac{N5}{180000} \cdot f_{VB} \dots \dots \dots (8)$$

$$f_{HET} = f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \dots \dots \dots (9)$$

$$f_{CAR1} = \frac{1}{100} \cdot f_{VCO4} = \frac{N4}{180000} \cdot f_{CP} \dots \dots \dots (10)$$

$$f_{CAR2} = \frac{1}{2} \cdot f_{STD} - \frac{1}{100} \cdot f_{VCO5} = \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} \dots \dots \dots (11)$$

$$f_{CAR0} = f_{CAR2} - f_{CAR1}$$

$$= \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} - \frac{N4}{180000} \cdot f_{CP} \dots \dots \dots (12)$$

Therefore, the term " $f_{IN}$ " of equation (1) is re-written as follows.

$$f_{IN} = \left( \frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000} - \frac{N0}{1000} \right) \cdot f_{STD} \dots \dots \dots (13)$$

As shown in equation (13), the receiver frequency is determined only by the reference  $f_{STD}$  and the dividing ratio  $N0-N3$ . This shows the following.

1. N is the numeric value determined by the microprocessor in accordance with the operating frequency and, essentially, does not include an error component.
2. With the primary term of  $f_{STD}$  only, the reference frequency accuracy is directly considered as an operating frequency accuracy.
3. The operating frequency does not change even if  $N4$ ,  $N5$ ,  $f_{CP}$  and  $f_{VB}$  change.

The accuracy of the reference crystal oscillator used in the TS-940 is 10PPM ( $-10 \sim +50^{\circ}\text{C}$ ). It is 0.5PPM ( $-10 \sim +50^{\circ}\text{C}$ ) when the optional TCXO (Temperature Compensated Crystal Oscillator) S0-1 is used.

According to 1. and 2, the overall accuracy of the TS-940 is highly stable with the same value as described above obtainable at any point in the 30kHz-30MHz range. Utilizing the characteristic of 3 above, the TS-940 has variable bandwidth functions such as VBT and slope tuning controlled by the microprocessor, which operates  $N4$  and  $N5$ . At the same time, the TS-940 sets the carrier point by making fine adjustment of  $f_{CP}$  and adjusts the initial setting of VBT by making fine adjustment of  $f_{VB}$ .

CIRCUIT DESCRIPTION

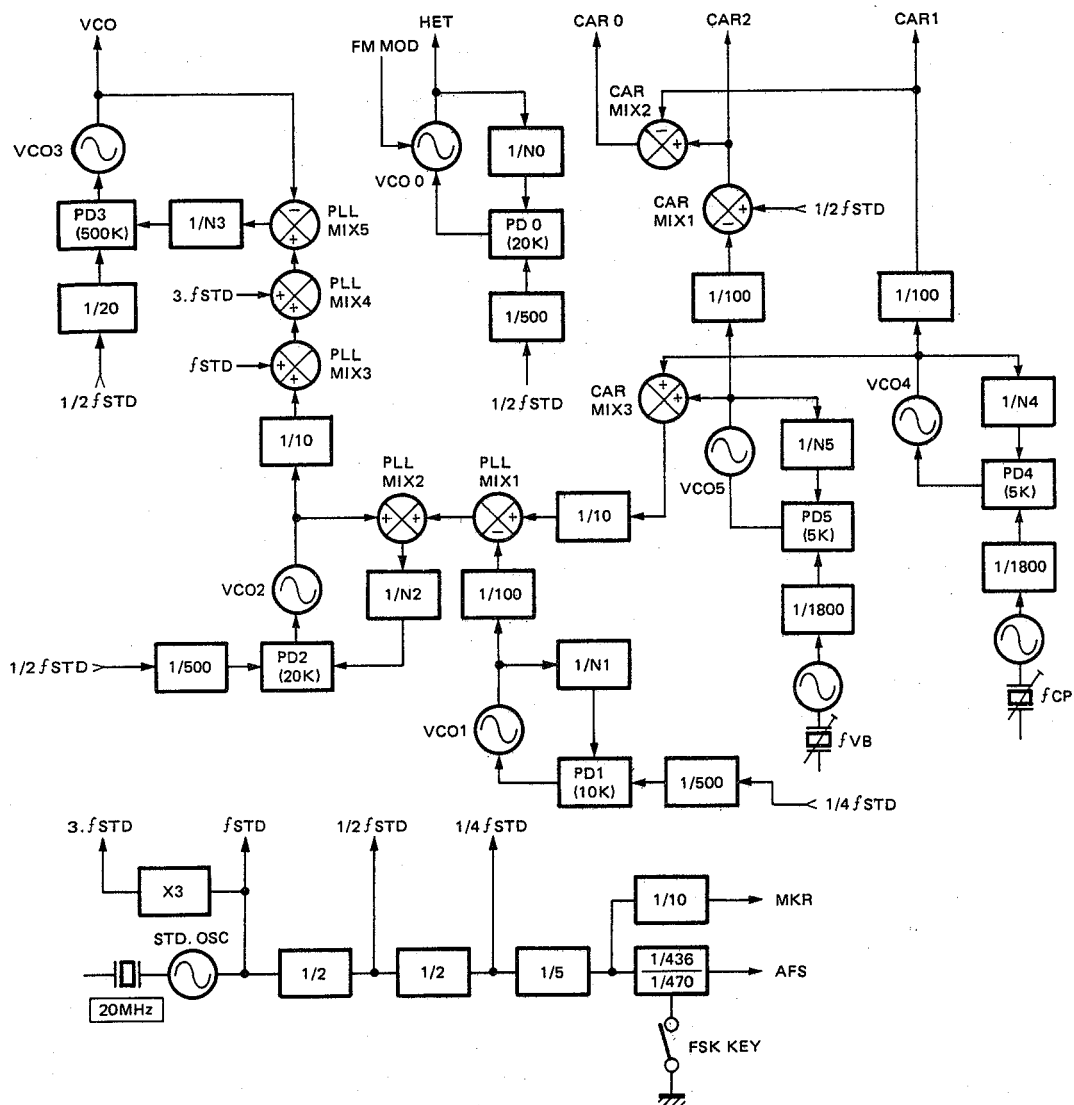


Fig. 2 TS-940S PLL channel

The receiver frequency in SSB mode has been described. In other modes or when used as a transmitter, likewise, the frequency is determined by the reference fSTD and dividing ratio. The display frequencies are as shown in the following table.

USB, LSB	Carrier point frequency
CW	Transmission carrier frequency
AM, FM	IF filter center frequency
FSK	Space transmitter frequency

Table 2 Display frequency in each mode

## CIRCUIT DESCRIPTION

In CW mode, the TS-940 receiving pitch can be changed to the required frequency while the desired signal remains in the center of the IF filter passband. (Variable CW pitch system)

The receiving pitch is interlocked and varies with the transmitter CW side tone. It is thus possible to immediately zero-beat by receiving the desired signal at the same pitch as the side tone. FSK transmission is executed in LSB mode. The audio signal made by dividing the reference frequency

$$(\text{space} = \frac{f_{STD}}{8720} \approx 2.2936\text{kHz}, \text{mark} = \frac{1}{9400} = 2.1277\text{kHz}) \text{ is}$$

used as the AFSK (Audio Frequency Shift Keying) signal.

fSTD	20MHz	Standard : $\pm 10\text{PPM}$ ( $-10^{\circ}\text{C} \sim +50^{\circ}\text{C}$ ) max.
fCP	9MHz $\pm\Delta\text{CP}$	SO-1 mounted : $\pm 0.5\text{PPM}$ ( $-10^{\circ}\text{C} \sim +50^{\circ}\text{C}$ ) max.
fVB	9MHz $\pm\Delta\text{VB}$	$\Delta\text{CP}$ = Carrier point adjustment component
	Dividing ratio	$\Delta\text{VB}$ = VBT initial setting adjustment component
N0	1811	
N1	10000-10999	Applicable to the display frequency 0.00kHz-9.99kHz + 229 added in FSK mode.
N2	2310-2555	Applicable to display frequencies 000.00-490.00kHz and 500.00-990.00kHz. (Only the integer multiple of 5 is used.)
N3	77-17	Applicable to every multiple of 500kHz within 30kHz-30MHz.
N4	9100 + (Mode shift) $\pm\Delta 4$	$\Delta 4$ = Variable band
	USB -30	AM-W, N 0
	LSB +30	FM 0
	CW-W -14	FSK-W, N +44
	CW-N 0	
N5	14300 $\pm\Delta 5$	$\Delta 5$ = Variable band

### Local oscillator

#### PLL Circuit

This is a digital VFO (Variable Frequency Oscillator) to cover a frequency range of from 45.08MHz-75.05MHz in 10Hz steps, in accordance with the TS-940s operating frequency of 30kHz-30MHz. Five PLL loops are linked in analog mode. The dividing ratio data to each PLL is controlled by the microprocessor.

In FSK mode, unlike the operation in LSB mode, the IF is shifted (the dividing frequency N4 is shifted) for both transmission and reception so that the signal at 2.2936kHz/2.1277kHz passes through the center of the IF filter. The fVCO1 is shifted, since the display frequency is the space transmitter frequency. (The dividing ratio N1 is shifted.)

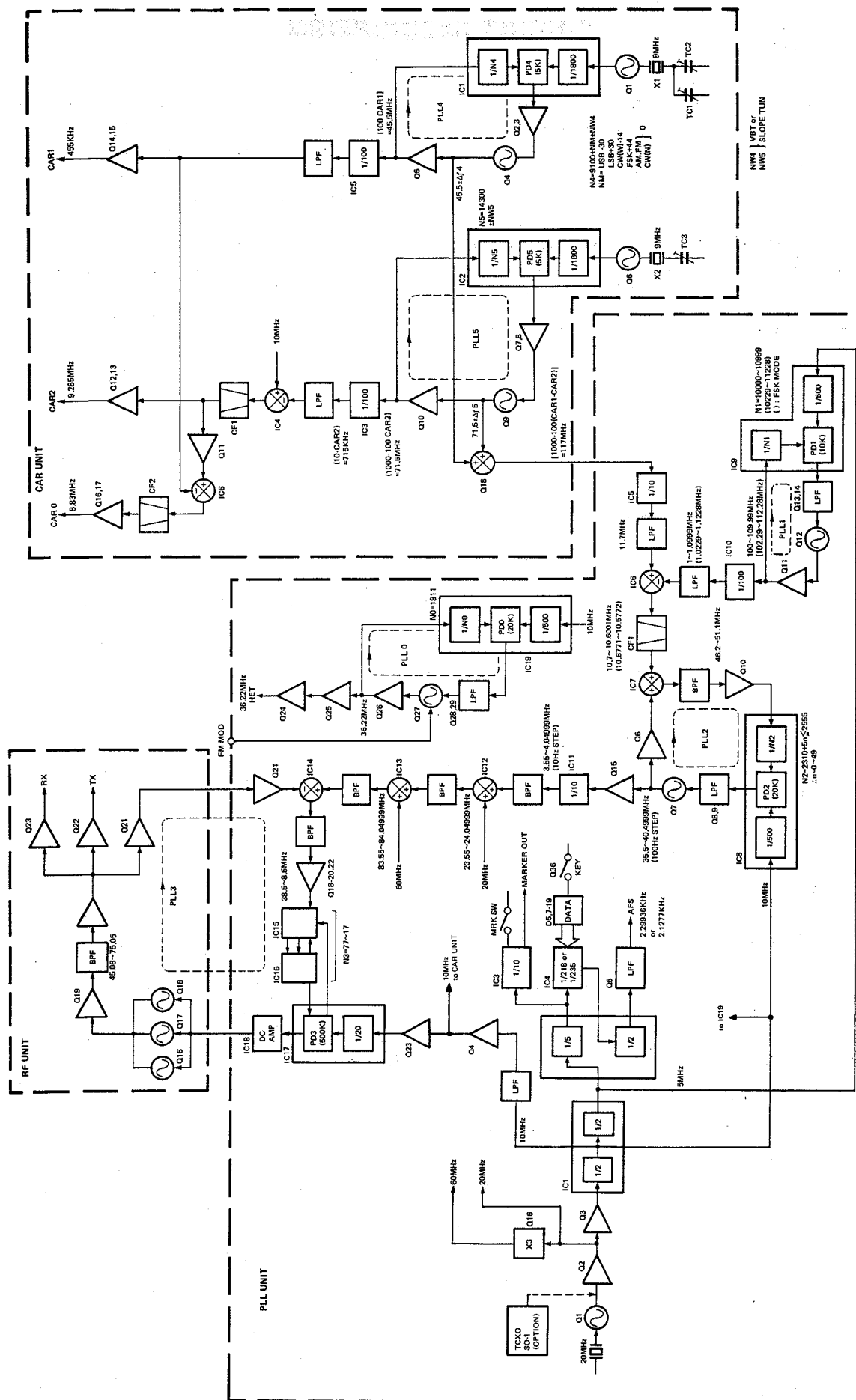
FM transmission is obtained in this system by modulating the fHET by applying the audio signal from the microphone to the VCO0.

The specifications of each frequency element are as follows.

Each loop is of a single crystal frequency control system : the VCO phase is compared with the unique reference frequency fSTD · CAR1 and CAR2 frequencies are inserted halfway in the analog link, enabling variable bandwidth functions such as VBT and slope tuning.

Operation of the PLL circuit is explained with reference to **Fig. 3** "PLL block diagram"

## 6



**Fig. 3 PLL block diagram**

## CIRCUIT DESCRIPTION

The PLL-1 consists mainly of IC9 : MN6147. VCO1 of Q12 : 2SC2668 is locked in the 100-109.99MHz range. The 1/4 fSTD (5MHz) signal is supplied from the reference signal generator to IC9, where it is divided to 1/500 and output as a 10kHz comparison frequency.

The VCO1 output is applied to the same IC9 via buffer amplifier Q11, where it is divided to 1/N1. The signal is then coupled to the phase comparator, where it is compared with the above 10kHz signal, and the output locks PLL-1 in 10kHz steps.

As N1, the 1000 steps (10000-10999) of dividing data equivalent to the low order 9.99kHz width of the operating frequency is sent from the digital A unit to the PLL unit as a 4 bit serial data stream. A microprocessor is used for this data sending operation. (DA0-DA3, CK1) In FSK mode, as the space frequency is used as an operating frequency, N1 is shifted to 10229-11228.

The PLL-1 output is divided to 1/100 by IC10 : M54459L and becomes a signal of 1MHz-1.0999MHz (1.0229-1.1228MHz in FSK mode) in 100Hz steps. This signal sent from the PLL-1 channel to IC6 : SN16913P, i.e., the signal sent from the PLL-1 channel to IC6 is :

$$\frac{f_{VCO1}}{100} = \frac{1}{100} \times \frac{N1}{500} \times \frac{1}{4} \cdot f_{STD} = \frac{N1}{200000} \cdot f_{STD} \dots\dots\dots(1)$$

On the other hand, the fVCO4 + fVCO5 signal (approx. 117MHz) is sent from the carrier unit to PLL unit. This signal is divided to 1/10 by IC5 : HD10551 and applied to the mixer IC6. This signal is expressed by the equation :

$$\frac{1}{10} \cdot (f_{VCO4} + f_{VCO5}) = \frac{1}{10} \left\{ 100 \cdot f_{CAR1} + 100 \left( \frac{1}{2} f_{STD} - f_{CAR2} \right) \right\} \\ = 5 \cdot f_{STD} + 10 f_{CAR1} - 10 f_{CAR2} \dots\dots\dots(2)$$

It becomes a signal of approx. 11.7MHz. Therefore, IC6 output becomes a signal of approx. 10.65MHz expressed by :

$$5 f_{STD} + 10 f_{CAR1} - 10 f_{CAR2} - \frac{N1}{200000} \cdot f_{STD} \dots\dots\dots(3)$$

Any mixer spurious is eliminated by ceramic filter CF1 : SFJ10.7MA-D and applied to the next PLL-2 loop. PLL-2 consists mainly of IC8 : MN6147, which locks the output signal of mixer IC7 : SN16913P, which is the VCO2 output of Q7 : 2SC2668 and the signal from CF1, in the range of 46.2-51.1MHz. The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC8, where it is divided to 1/500 to make a comparison frequency of 20 kHz. The VCO2 output is applied to mixer IC7 via buffer amplifier Q6 : 2SC2668 and added to the signal (the configuration of equation (3) = 10.65MHz) from CF1, and this output is sent to IC8 via a BPF (Band Pass Filter) and amplifier Q10 : 2SC2668.

This signal is divided to 1/N2, compared in phase with the above 20kHz signal and used to control VCO2. This operation is expressed by :

$$(f_{VCO2} + 5 f_{STD} + 10 f_{CAR1} - 10 f_{CAR2} - \frac{N1}{200000} \cdot f_{STD}) \\ \times \frac{1}{N2} = \frac{1}{500} \times \frac{1}{2} f_{STD} \dots\dots\dots(4)$$

N2 means to cover the low order 500kHz width of the operating frequency in 10kHz steps and takes a numeric value of 50 steps which becomes an integer multiple of 5 in the range 2310-2555. Like N1 in PLL-1, this data is sent by the microprocessor from the digital A unit to the PLL unit IC8 as a 4 bit serial data stream. (DA0-DA3, CK2) Therefore, the output signal of PLL-2 is expressed by the equation :

$$f_{VCO2} = \left( \frac{N1}{200000} + \frac{N2}{1000} - 5 \right) f_{STD} - 10 f_{CAR1} + 10 f_{CAR2} \dots\dots\dots(5)$$

According to the values of N1 and N2, a frequency of 35.5-40.4999MHz is generated in 100Hz steps. The PLL-2 output is divided to 1/10 by IC11 : HD10551 via buffer amplifier Q15 : 2SC2668, and becomes a signal in 10Hz steps in the 3.55-4.04999MHz range.

First, fSTD (20MHz) is added in mixer IC12 : SN16913P and then, 3.fSTD (80MHz) is added in mixer IC13 : SN16913P and the signal is converted to 83.55-84.04999 MHz. As a result, 4.fSTD (80MHz) is added, but such a frequency configuration is employed in order to avoid unwanted mixer spurious components. This signal is applied to mixer IC14, where it is mixed with the final VCO output signal.

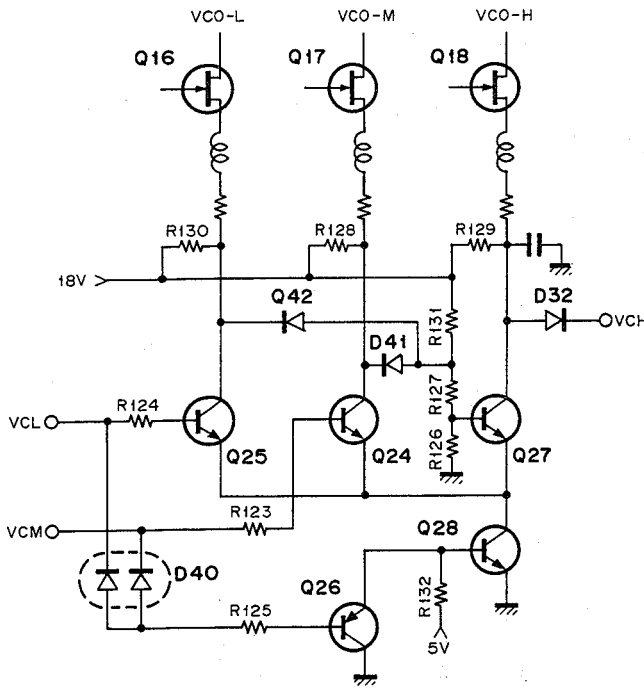
Item	Rating
Center frequency	D : 10.64MHz±30kHz (Black)
3dB band width	280±50kHz within
50dB bandwidth	750kHz or less
Insertion loss $20 \cdot \log \left( \frac{E1}{2E2} \right)$	7±2dB within
Spurious attenuation	55dB or more at 9-13MHz
Input and output impedance	330Ω

**Table 3 PLL ceramic filter (L72-0349-04) (PLL unit CF1)**

CIRCUIT DESCRIPTION

The final VCO is located on the RF unit and consists of three elements : Q16 : 2SK192A handling the frequency below 9.5MHz, Q17 : 2SK192A for 9.5-19.5MHz and Q18 : 2SK192A for 19.5MHz-30MHz. Each VCO is selected by the VCO select information (VCM or VCL, VCH is derived) sent from the Digital A unit by the microprocessor. The VCO selector circuit is shown in Fig. 4.

The oscillator output runs through the buffer amplifier Q19 : 2SC1907 and the high frequency component is eliminated by a BPF. The signal runs through the buffer amplifier Q20 : 2SC1907 and is then separated into three channels of buffered output. The Q21 : 2SC2668 output is supplied to the PLL unit, composing a final PLL loop. The Q22 : 2SC1907 output is applied to the third transmitter mixer. From Q23 : 2SC1907, the VCO output is applied to the first receiver mixer via amplifier Q6 : 2SC2053.



Freq' (Hz)	VCO selected data		Q25	Q24	Q27	VCO freq' (MHz)	VCH
	VCM	VCL					
30k-9.5M	L	H	O	X	X	45.08-54.55	H
9.5M-19.5M	H	L	X	O	X	54.55-64.55	H
19.5-30M	L	L	X	X	O	64.55-75.05	L

O : ON X : CUT OFF

Fig. 4 VCO selector circuit

The signal from the RF unit final VCO is connected to the PLL unit VCO terminal and is applied to mixer IC14 via buffer amplifier Q21 : 2SC2668. Therefore, the mixer output becomes :

$$\frac{f_{VCO2}}{10} + f_{STD} + 3f_{STD} - f_{VCO} = \left( \frac{N1}{2000000} + \frac{N2}{10000} + \frac{7}{2} \right) f_{STD} - f_{CAR1} + f_{CAR2} - f_{VCO} \dots\dots\dots(6)$$

This signal goes through a BPF and is amplified by Q18, 19 : 2SC2668, Q20 : 2SC1907 and Q22 : 2SC2668 and then, waveform shaped by IC15-1/3 : SN74S10N and applied to 1/3 or 1/4 prescaler IC16 : SN74S112N. IC16 is originally a dual function flip-flop circuit and works as a 1/4 divider, but its function is changed to a 1/3 divides by the control signal from the later stage PLL IC17 : MC145158, i.e., a pulse swallow divider is composed of IC17 internal divider, IC16 and IC15-1/3.

PLL IC17, the primary element of the final PLL loop PLL-3, is provided with the modulus control function which externally sets both the reference dividing ratio and comparison dividing ratio by serial data, and composes a pulse swallow counter using an external prescaler.

The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC16 via buffer amplifier Q23 : 2SC2668. The signal is divided to 1/20 in IC16 to make a comparison output frequency of 500kHz.

The signal supplied from IC14 to the swallow counter via the BPF and amplifier is divided to 1/N3 and compared in phase with the 500kHz signal in the phase comparator. This controls the RF unit final VCO by the error correction voltage.

The operation is expressed by :

$$\left\{ \left( \frac{N1}{2000000} + \frac{N2}{10000} + \frac{7}{2} \right) f_{STD} - f_{CAR1} + f_{CAR2} - f_{VCO} \right\} \times \frac{1}{N3} = \frac{1}{20} \times \frac{1}{2} f_{STD} \dots\dots\dots(7)$$

N3 means to cover the overall operating frequency range (30kHz-30MHz) in 500kHz steps and becomes 60 steps of 77-17. This data is also sent by the microprocessor from the Digital A unit to the PLL unit as serial data. (PLD, PLE and CK3)

As a result, the final VCO output signal is expressed by :

$$f_{VCO} = \left( \frac{160-N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000} \right) \cdot f_{STD} - f_{CAR1} + f_{CAR2} \dots\dots\dots(8)$$

According to the values of N1, N2 and N3, a frequency of 45.08-75.05MHz is generated in 10Hz steps. If fCAR1 is expressed by N4 and fCP and fCAR2 by N5, fVB and fSTD' respectively, equation (8) becomes the same as equation (8) provided in "Frequency Configuration".

## CIRCUIT DESCRIPTION

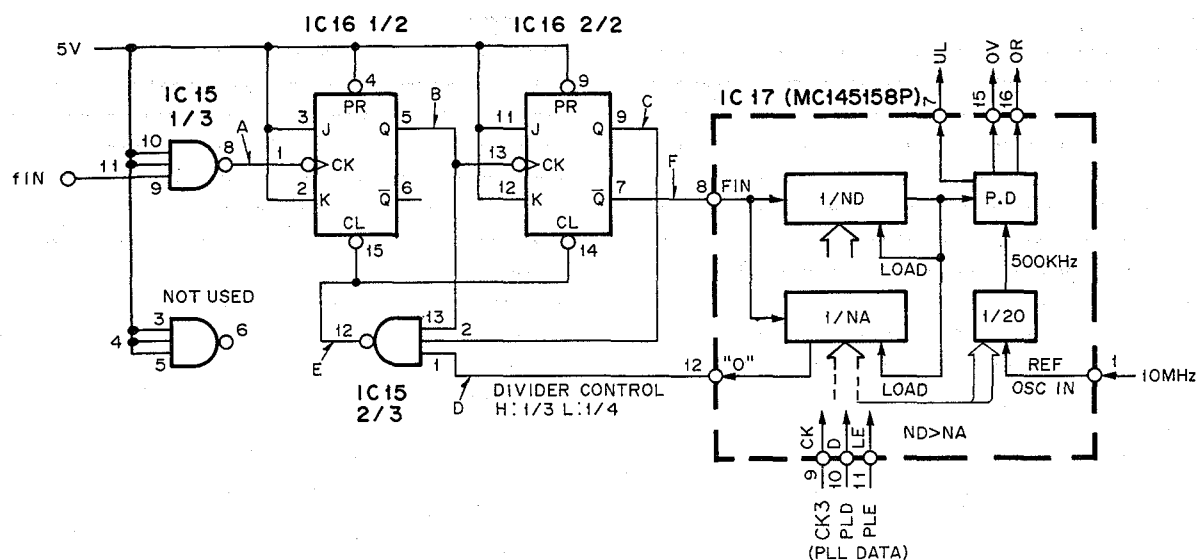


Fig. 5-A Pulse swallow divider circuit

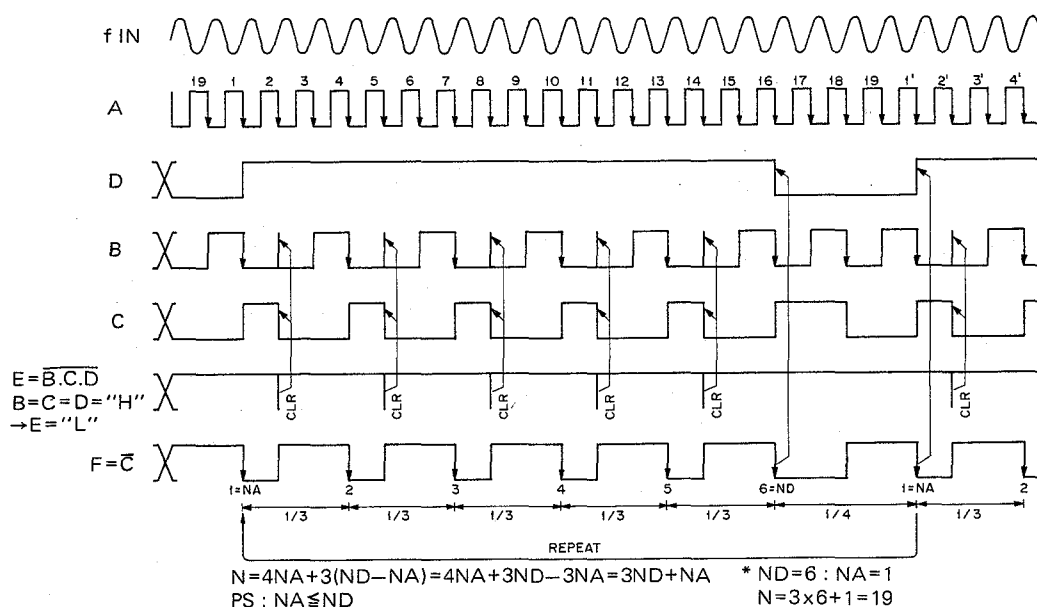


Fig. 5-B Pulse swallow divider timing chart (At 29.0–29.5MHz band, ND=6, NA=1)

### ● HET (Heterodyne Oscillator)

The HET oscillator is provided in the PLL unit, which is a PLL circuit (PLL-0) to generate a constant frequency signal of 36.22MHz. This output signal is connected to the IF unit and supplies the second transmitter/receiver mixer. In FM transmission mode, the audio signal from the microphone is applied to this PLL to yield FM modulation.

PLL-0 consists mainly of IC19. VCO 0 is Q29 : 2SK129A, locked to 36.22MHz. A signal of 1/2  $f_{STD}$  (10MHz) is supplied from the reference frequency generator to IC19, where it is divided to 1/500 to make a 20kHz comparison output frequency.

The oscillator output of VCO 0 is applied to IC19 via buffer amplifier Q26 : 2SC2668 and divided to 1/N0 (1/1811 constant) and the output is phase compared with the 20kHz reference signal in the phase comparator. This is used to lock the frequency of VCO 0. N0 (1811) is sent from the Digital A unit to the PLL unit. (DA0-DA3, CK0) The PLL-0 output is sent to the IF unit via buffer amplifiers Q25 : 2SC2668 and Q24 : 2SC1907 and an LPF (Low Pass Filter).

## CIRCUIT DESCRIPTION

### • CAR1

The CAR1 generator is provided in the digital B (CAR) unit, which makes a signal of approx. 45.5MHz on the basis of the 9MHz crystal oscillator and divides it to 1/100 in the PLL-4 circuit to generate a 455kHz signal. This signal is sent to the IF unit and mixed with the CAR3 signal to become a 355kHz signal. This is sent to the fourth receiver mixer in reception mode. In transmission mode, the signal is sent to the balanced modulator to generate a 455kHz DSB (Double Side Band) signal.

PLL-4 consists mainly of IC1 : MN6147. VCO4 (Q4 : 2SC2668) is locked to approx. 45.5MHz. A 9MHz signal is supplied from the fCP oscillator Q1 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. VCO4 output is applied to IC1 via buffer amplifier Q5 : 2SC2668 and divided to 1/N4, and the output is phase compared with the 5kHz signal and is then used to lock VCO4 in 5kHz steps. The output signal from PLL4 is divided to 1/100 by IC5 : M54459L to become a signal of approx. 455kHz in 50Hz steps. This passes through the LPF and is supplied from output buffer Q14/Q15 : 2SC2458 to the IF unit as the CAR1 signal.

The non-divided 45.5MHz signal is applied to the mixer Q18 : 3SK73, where the PLL-5 output (the base of CAR2 signal) is added to the signal, and the output is sent to the PLL unit to form a part of the digital VFO.

Thus, the operating frequency is not changed even if the CAR1 frequency is changed, i.e., fCP and N4 are optional. When fCAR1 is changed, IF shift is effected in both transmission and reception modes. This characteristic is used to realize USB/LSB mode switching functions, variable bandwidth, fine adjustment of carrier point, centering CW/FSK signals in the IF bandpass, etc. Fine adjustment of carrier point is provided by trimmer capacitors TC1 (for USB) and TC2 (for LSB) connected to the fCP crystal oscillator X1. The other functions are executed by controlling N4 from the microprocessor. N4 is sent from the Digital A unit (a part of it is relayed by the PLL unit) as 4bit serial data. (A0-A3, CL4).

Mode	N4 Normal	SLOPE TONE or CW VBT : MAX	CAR/FREQ' (kHz)
USB	9070	→ 9039	453.50 → 451.95
LSB	9130	→ 9161	456.50 → 458.05
CW-W	9086	→ 9071	454.30 → 453.55
CW-N	9100	→ 9093	455.00 → 454.65
AM-W	9100	→ 9069	455.00 → 453.45
AM-N	9100	→ 9085	455.00 → 454.25
FM	9100	—	455.00 → —
FSK-W	9144	→ 9175	457.20 → 458.75
FSK-N	9144	→ 9151	437.20 → 457.55

Table 4 N4 data shift

### • CAR2

The CAR2 circuit is provided in the digital B (CAR) unit, which generates a signal of approximately 71.5MHz on the basis of the 9MHz crystal oscillator. This is divided to 1/100 in the PLL-5 circuit to generate a 9.285MHz signal. This signal is sent to the IF unit and used as a local oscillation signal for the third receiver mixer in reception mode, and that of the first transmitter mixer in transmission mode. PLL-5 consists mainly of IC2 : MN6147.

A 9MHz signal is supplied from the fVB oscillator Q6 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. The output of VCO5, Q9 : 2SC2668 is applied to IC2 via buffer amplifier Q10 : 2SC2668 and divided to 1/N5, and the output is compared in phase with the 5kHz signal and used to lock VCO5 to approx. 71.5MHz in 5kHz steps. The PLL-5 output signal is divided to 1/100 by IC3 : M54459L to become a signal of approx. 715kHz in 50Hz steps. It passes through a LPF and goes to IC4 : SN16913P, where it is mixed with 1/2 fSTD (10MHz) from the reference frequency generator to become the CAR2 signal at 9.285MHz. Any mixer spurious components within this signal are eliminated in ceramic filter CF1. The filtered signal is applied to the IF unit via buffer amplifier Q12/Q13 : 2SC2458. The 71.5MHz output signal from PLL-5 is applied to mixer Q18, where the PLL-4 output signal (the basis of the CAR4 signal) is added to the signal, and the output is sent to the PLL unit to form a part of digital VFO. Thus, like CAR1, the operating frequency is not changed even if the CAR2 frequency is changed, i.e., fVB and N5 are optional.

However, if the fCAR2 is changed, IF shift is effected across the 8.83MHz filter (the second receiver IF filter) in both transmission and reception. (When the fCAR2 is changed, the 455kHz filter is not shifted.) This characteristic is used to realize the variable bandwidth function.

Initialization of the VBT (Variable Bandwidth Tuning) adjustment (making the band center frequencies of the 8.83MHz and 455kHz filters the same) is performed by trimmer capacitor TC3 connected to the fVB crystal oscillator X2. The actual variable bandwidth function is realized by controlling N5 by the microprocessor. N5 is sent from the Digital A unit as A0-A3, and CL5 data.

Mode	N5 Normal	SLOPE TONE or CW VBT : MAX	CAR/FREQ' (kHz)
USB	14300	→ 14378	9285.00 → 9281.10
LSB	14300	→ 14222	9285.00 → 9288.90
CW-W	14300	→ 14362	9285.00 → 9281.90
CW-N	14300	→ 14315	9285.00 → 9284.25
AM-W	14300	→ 14362	9285.00 → 9281.90
AM-N	14300	→ 14330	9285.00 → 9283.50
FM	14300	—	9285.00 → —
FSK-W	14300	→ 14238	9285.00 → 9288.10
FSK-N	14300	→ 14285	9285.00 → 9285.75

Table 5 N5 data shift



## CIRCUIT DESCRIPTION

### • CAR0

CAR0 is a signal of approx. 8.83MHz, which is derived by subtracting CAR1 from CAR2 in mixer IC6 provided on the CAR unit. Any mixer spurious components generated by IC6 : SN16913P are eliminated by ceramic filter CF2. The signal is then applied to both the IF and Control units via Q16 : 2SC2787 and Q17 : 2SC2458.

The signal applied to the IF unit is used as a transmission carrier in the CW and FM modes. The signal applied to the Control unit is used as the demodulation carrier for the monitor circuit in the SSB and FSK modes.

Item	Rating
Nominal center frequency	9.285MHz
3dB Attenuation bandwidth	±50kHz or more at 9.285MHz
Guaranteed attenuation	45dB or more at 8.83MHz (-455kHz)
	45dB or more at 9.74MHz (+ 455kHz)
	40dB or more at 10.715MHz (+1430kHz)
Insertion loss $20 \cdot \log \left( \frac{E1}{2.2E} \right)$	6dB or less
Ripple (within 3dB band)	1.0dB or less
Input and output impedance	330Ω
Voltage capacity	DC50V (1 minutes)

**Table 6 CAR ceramic filter (L72-0350-05)  
(CAR unit CF1, IF unit CF3)**

Item	Rating
Nominal center frequency	8.830MHz
3dB bandwidth attenuation	±50kHz or more at 8.830MHz
Guaranteed attenuation	35dB or more at 9.285MHz (+ 455kHz)
	45dB or more at 9.74MHz (+ 910kHz)
Insertion loss $20 \cdot \log \left( \frac{E1}{2.2E} \right)$	6dB or less
Ripple (3dB bandwidth)	1.0dB or less
Input and output impedance	330Ω

**Table 7 CAR ceramic filter (L72-0351-05) (CAR unit CF2)**

### • CAR3

CAR3 on the IF unit generates three different frequencies depending on the mode (100kHz = CW, AM and FM, 98.5kHz = USB and 101.5kHz = LSB and FSK.) These are used as the BFO (Beat Frequency Oscillator) in the SSB and FSK modes, as a side tone generating carrier in the CW mode, and as a local oscillators signal for the fourth receiver mixer after being mixed with the CAR1 signal.

In CAR3, the tuning capacitors for each mode are selected by diode switches D69 and D70. Q33 : 3SK92A is the oscillator. The output is supplied from the CAR3 terminal to the side tone generator on the Control unit via buffer amplifier Q32 : 2SC2458, and at the same time, it is mixed with

the CAR1 signal from CAR unit in mixer Q34 : 3SK73 to generate a local oscillator signal (fCAR1 - fCAR3) to be applied to the fourth receiver mixer. The output of Q32 is further applied to the SSB and FSK product detectors via buffer amplifiers Q31 and Q14 : 2SC2458.

### • CAR4

CAR4 on the IF unit serves as a BFO dedicated to CW demodulation, and as a side tone generating carrier. The oscillator frequency is 99.2kHz, but it is varied by the CW PITCH control so the receiving pitch can be set to the desired frequency in the CW mode. The CAR4 signal is generated by Q16 : 2SK192A and is applied to buffer amplifier Q15 : 2SC2458. The output is supplied from the CAR4 terminal to the Control unit generator side tone and, at the same time, it is applied to buffer amplifier Q14 via diode switches D34 and D68 and connects to the CW detector.

### • Reference frequency generator

The reference frequency fSTD' the frequency control base of the TS-940, is generated by the 20MHz crystal oscillator X1 and Q1 : 2SC2668 on the PLL unit, and further applied to buffer amplifier Q2 : 2SC2787. X1 and Q1 are replaceable by the optional TCXO (Temperature Compensated Crystal Oscillator) SO-1.

The output of Q2 is used as the 20MHz fSTD as is. It is also multiplied three times to provide 60MHz 3fSTD. Further, it is divided to 1/2 by half of IC1 : SN74LS73AN to provide 10MHz 1/2 fSTD. This 1/2 fSTD is supplied to the CAR unit via buffer amplifier Q4 : 2SC2787 as well as being used in the PLL unit. The 1/2 fSTD is further divided to 1/2 by the other half of IC1 to provided a 5MHz 1/4 fSTD.

### • AFSK signal and marker signal

A part of the 5MHz (1/4 fSTD) signal generated by the PLL unit frequency generator reference is applied to 1/5 divider IC2 : SN74LS90N to provide a 1MHz (1/20 fSTD) signal. This signal is applied to programmable divider IC4 : MC14569BCP. The dividing ratio of this IC is switched between 218/235 interlocked with the FSK key SPACE/ MARK setting. The output of IC4 returns to IC2, passes through the 1/2 divider, establishes a 50% duty cycle and is then sent to the microphone amplifier circuit of the IF unit via active LPF Q5 : 2SA1115, where it is converted to an FSK modulation signal. The total dividing ratio is 1/8720 fSTD (2.2936kHz) in SPACE and 1/9400 fSTD (2.1277 kHz) MARK. The shift width is 165.9Hz, which is a slight deviation from the standard value, but no problem in practical use.

The carrier frequency and shift width during transmission are the same in accuracy as fSTD' and are very stable. In modes other than FSK, IC4 stops operation and thus, an AFSK signal is not output.

The marker signal chain divides the 1MHz (1/20 fSTD) signal from the preceding stage IC2 to 1/10 through IC3 : SN74LS90N to generate 100kHz signals (1/200 fSTD). When the marker switch is off, IC3 is reset and the operation is stopped.

## CIRCUIT DESCRIPTION

### Receiver

The signal received through the antenna is applied to the RF unit (X44-1660-00) ANT terminal. The signal passes through the transmitter/receiver selector circuit and goes out from the EXT terminal. The output is connected to the RF unit RXA terminal via the selector circuit provided on the rear panel. This signal is applied to the receiver BPF through the RF attenuator (0, 10, 20, or 30dB selectable) via relays RL1 and RL2. The BPF divides the received frequency range (up to 30MHz) into nine bands, which are automatically selected by RX BPF control data (RB0—RB3) from the Digital A unit (X54-1830-00).

Received freq' (MHz)	RX BPF select data				RX BPF
	RB0	RB1	RB2	RB3	
— 0.5	0	0	0	0	A
0.5— 1.5	1	0	0	0	B
1.5— 3	0	1	0	0	C
3 — 4	1	1	0	0	D
4 — 7	0	0	1	0	E
7 — 8.5	1	0	1	0	F
8.5—14	0	1	1	0	G
14 —20	0	0	0	1	H
20 —30	1	1	1	0	I

**Table 8 Selection of RX BPF**

The signal from the BPF runs through the RF AGC circuit composed of PIN diodes D23 and D26 : MI204. It is then amplified by RF amplifier comprising Q10 : 2SK125 pair and applied to the first receiver mixer Q9 : 2SK125 pair, where it is mixed with the VCO signal, and the output is converted to the first IF signal at 45.05MHz. This signal is applied to the grounded gate post amplifier Q7, 8 : 2SK125, and the output is applied from the RIF terminal to IF unit (X48-1430-00).

The unwanted signal components are eliminated from the 45.05MHz first IF signal when it passes through the MCF XF1 with 15kHz bandwidth. The signal is then applied to the second receiver mixer Q4 and Q5 : 2SK125, mixed with the HET signal (36.22MHz) and converted to the second IF signal (8.83MHz). This signal is separated into two channels : one is supplied to the noise blanker on the Control unit (X53-1420-11), and the other is applied to the second IF signal filter circuit via the noise blanking gate comprised of diodes D3—D6 : 1S1587.

This filter circuit is provided with crystal filter XF2 : YK-88S1 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM), and wide band LC filters L37, L38 for FM (used also for wide AM when the optional AM filter is not provided.) As an option, the filter circuit permits use of two kinds of filters : a YK-88C-1 with 500Hz bandwidth for CW and a YK-88A-1 with 6kHz bandwidth for AM. These four filters types are automatically selected by the W/N-mode information (WN, ND2 and MD1) from the Digital A unit via the keyboard.

MODE	W/N SWITCH	WN	MD2	MD1	2nd IF	3rd IF
SSB	W	0	0	0	2.7kHz	2.7kHz
	N	1	0	0	2.7kHz	2.7kHz
CW, FSK	W	0	0	1	2.7kHz	2.7kHz
	N	1	0	1	2.7kHz (Option : 500Hz)	2.7kHz (Option : 500Hz or 250Hz)
AM	W	0	1	1	Wide band (Option : 6kHz)	6kHz
	N	1	1	1	2.7kHz	2.7kHz
FM	W	0	1	0	Wide band	* 6kHz
	N	1	1	0	Wide band	* 6kHz

\* : 12kHz B.W IF Filter used in FM mode.

**Table 9 Selection of filters**

The received signal, having passes through the second IF filter, is applied to the third receiver mixer Q7,8 : 3SK73 to be mixed with the CAR2 signal (9.285MHz) and then converted to the third IF signal (455kHz). The output is then separated into two channels. One is connected to the Control unit FIN terminal, goes through IF amplifier Q45 : 2SC2787 and third IF filter CF1 : CFV455F. It is then applied to limiter amplifiers IC11 and IC12 :  $\mu$ PC577H for amplitude limiting, and the output is applied to ceramic discriminators L12 : CFY455S for FM detection. The detected output is supplied from the FMV terminal to the IF unit for the FM mode signal via the de-emphasis circuit and, at the same time, the noise component near 40kHz is eliminated. The signal is then connected to the squelch circuit, noise amplifier Q46 and Q47 : 2SC2458, noise rectifier D80 and D81 : 1SS33 and the comparator consisting of IC13 2/2 : NJM4558S.

The above Control unit circuits function not only in the FM mode, but in all modes. Therefore, one noise squelch system is employed in all modes. The squelch control output mutes the IF unit audio amplifier via the MTU terminal. (IF unit Q28)

The third IF signal is amplified by Q10 : 3SK73 on the IF unit and is then applied to the filter circuit as the third IF signal.

This filter circuit is provided with ceramic filter CF1 : CFJ455K12 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM) and ceramic filter CF2 : CFW455HT with a 6kHz bandwidth for AM wide. As an option, the filter circuit provides for use of either a CW 500Hz crystal filter : YG-455C-1 or 250Hz : YG-455CN-1 bandwidth filter. These three filter types are automatically selected by information from the Digital A unit, like the second IF filters. For selection operaton data, refer to Table. 1. The signal from the third IF filter is amplified by Q11 : 3SK73 and applied to the fourth receiver mixer to be mixed with the 355kHz (CAR1—CAR3) signal and converted to the fourth IF signal. The output is applied to Q13 : 3SK73 via the notch filter circuit. This amplifier output is detected by either the SSB/CW product detector or the AM detector. The detected signal is applied to AF GAIN control via the squalch gate Q28 : 2SC2458 and preamplifier Q29 : 2SC2459. In CW mode, it is also possible to pass the signal through the AF TUNE circuit, IC1 and IC2 :

## CIRCUIT DESCRIPTION

BA718. The output of Q3 is also applied to the AGC circuit. The received AF signal from the AF GAIN control is applied to the Control unit, where it is amplified by the audio power amplifier IC15 : HA1368 and used to drive the speaker.

Item	Rating
Nominal center frequency (fo)	45.050kHz
Passband width	±7.5kHz or more at 6dB
Attenuation bandwidth	30dB or more at fo±25kHz 60dB or more at fo±150kHz Spurious level : 20dB or more
Guaranteed attenuation	60dB or more within fo±150kHz—fo±1000kHz
Ripple	1.5dB or less
Insertion loss	4dB or less

**Table 10 MCF (L71-0254-05) (IF unit XF1)**

Item	Rating
Nominal center frequency	8830kHz
Center frequency deviation	±150Hz within at 6dB
Passband width	±1.35kHz or more at 6dB
Attenuation bandwidth	±1.7kHz or less at 20dB ±2.5kHz or less at 60dB ±3.4kHz or less at 80dB
Ripple	2dB or less
Insertion loss	6dB or less
Guaranteed attenuation	80dB or more within ±3.4kHz—±1MHz
Input and output impedance	600Ω//15pF

**Table 11 MCF (L71-0222-05) (IF unit XF2)**

Item	Rating
Nominal center frequency	455kHz
6dB bandwidth	±3kHz or more
50dB bandwidth	±9kHz or less
Ripple (within 455 ± 2kHz)	2dB or less
Loss	6dB or less
Guaranteed attenuation (within 455kHz ± 100kHz)	60dB or more
Input and output impedance	2.0kΩ

**Table 12 AM ceramic filter (L72-0319-05) (IF unit CF2)**

Item	Rating
Center frequency	455 ± 0.20kHz
6dB bandwidth	2.9—3.2kHz
60dB bandwidth	4.7kHz or less
Guaranteed attenuation (0.1—1MHz)	60dB or more
Spurious (600—700kHz)	40dB or more
Ripple	2dB or less
Loss	6dB or less
Input and output impedance	2kΩ

**Table 13 SSB ceramic filter (L72-0333-05) (IF unit CF1)**

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±70Hz at 6dB (25°C)
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±900Hz or less at 60dB
Guaranteed attenuation	80dB or more within ±2kHz—±1MHz
Ripple	2dB or less
Loss	Within 5dB ± 2dB
Input and output impedance	600Ω / 15pF

**Table 14 CW crystal filter YK-88C-1  
(L71-0236-05) Option**

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±250Hz at 6dB
Pass bandwidth	±3.0kHz or more at 6dB
Attenuation bandwidth	±6kHz or less at 60dB ±10kHz or less at 80dB
Ripple	2dB or less
Loss	Within 3dB ± 2dB
Guaranteed attenuation	80dB or more within ±10kHz—±1MHz
Input and output impedance	600Ω / 15pF

**Table 15 AM crystal filter YK-88A-1  
(L71-0237-05) Option**

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±425Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.4kHz 80dB or more within 455.6kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

**Table 16 CW crystal filter YG-455C-1  
(L72-0238-05) Option**

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±125Hz or more at 6dB
Attenuation bandwidth	±250Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.6kHz 80dB or more within 455.4kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

**Table 17 CW crystal filter YG-455CN-1  
(L72-0239-05) Option**

## CIRCUIT DESCRIPTION

## Additional circuit

## ● Noise blanker (provided on the Control circuit)

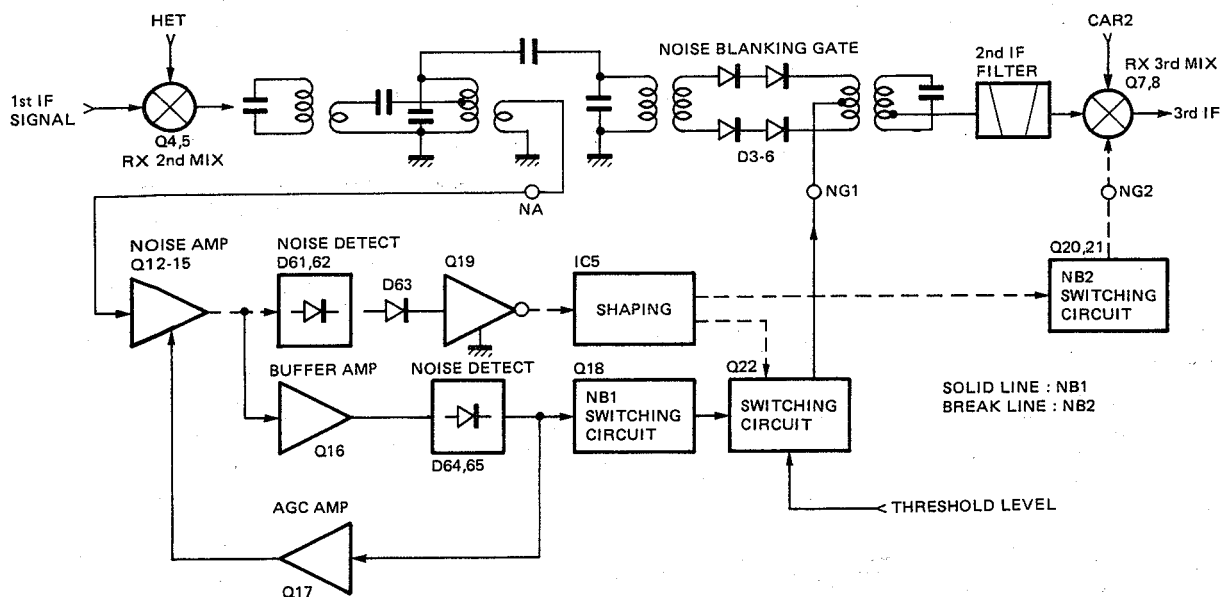
**Fig. 6** give a block diagram of the noise blanker. This circuit is comprised of two channels, NB1 and NB2. The signal taken from the tuned output circuit of the second receiver mixer, comprised of Q4 and Q5 on the IF unit, is supplied from the NA terminal to the Control unit and amplified approx. 70dB by Q12–Q15.

In the case of the NB1 channel, the noise signal is detected by diodes D64 and D65 through the buffer Q16 and then applied to the switching transistors Q18 and Q22. In the case of the NB2 channel, the noise is directly applied to the noise detector comprising D61 and D62. The NB1 channel takes out only the pulse noise contained in the input signal and switches the noise blanking gate composed of diodes D3–D6, located before the IF unit XF2.

NB1 channel operation is conventional. On the other hand, the noise output detected by D61 and D62 in the NB2 channels is waveform shaped by IC5 after running through D63 and Q19, and only the high level pulse component is taken out as a square wave.

This component is switched by Q38 and in turn is used to switch the NB gate via D66 and Q22. At the same time, it is also used for switching the third receiver mixer Q7, Q8 on the IF unit via Q20 and Q21. The NB2 channel is especially effective for that special noise known as "the woodpecker".

In addition, in the TS-940, the "click" noise generated when the frequency is changed one step by the digital VFO is eliminated through the NB2 channel by utilizing the BLK signal from the Digital unit. The functions of the NB circuit are described in detail below.



**Fig. 6 Noise blanker circuit**

In **Fig. 7**, Q18 and Q22 form a conventional NB circuit, which controls the NB gate. When the NB1 switch S14 is turned on, Q18 turns on and controls Q22 according to whether or not a pulse noise exists, and opens or closes the NB gate comprising D3–D6 on the IF unit.

NB LEVEL (VR7) varies the operating threshold of Q18 so the NB effect can be varied.

Next, NB2 is explained. When a signal corresponding to a noise is applied to Q19, the collector of Q19 is set to a low level (hereafter abbreviated Lo. (and high level to Hi.). IC5, pins 11 and 9 are Hi, because pin 12 is Lo due to R172. As described above, when the collector (IC5, pin 8) of Q19 becomes Lo, IC5, pin 10 becomes Hi. As pin 10 next be-

comes Hi, a charging current flows in C76, pin 12 becomes Hi and pins 11 and 9 become Lo, in sequence.

As pin 9 becomes Lo, pin 10 is held Hi. This holding time is determined by the charge constant of C76 and R172, approx. 4ms. If this time is exceeded, pins 11 and 9 are returned to their initial states, Hi.

During this period, the conventional NB1 channel is operating through D66, and Q20 and Q21 are operating, whereby the third mixer (Q7 and Q8 on the IF unit) is cut off. Even if pins 11 and 9 become Hi, the base voltage of Q21 is in the state of cutting off the charging voltage determined by R175 and C78, and it continuously cuts off the third mixer. This is the control for NB2.

## CIRCUIT DESCRIPTION

IC5, pin 6 is connected by R171 (56k $\Omega$ ) and returned to Hi when the NB2 control time (about 4ms) elapses. Upon this change from Lo to Hi, a charging current flows in C77 through R173 and changes pins 1 and 2 from Lo to Hi. IC5, pins 3 and 5 become Lo, keeping pin 4 Hi and holding the charging time determined by C77 and R173, approx. 80ms. During this period, IC5, pin 13 is held Lo (pin 11 is Hi) through D68 so the NB2 does not mis-fire with a normal pulse for approx. 80ms from the time the first noise pulse goes out, even if a pulse noise is again entered. This is the operation for periodic woodpecker noise. When the NB2 channel is on, conventional noise is also blanked because one pole of S15 operates the NB1 circuit.

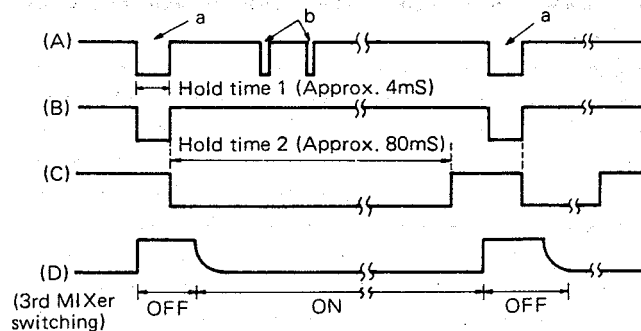


Fig. 8 NB2 timing chart

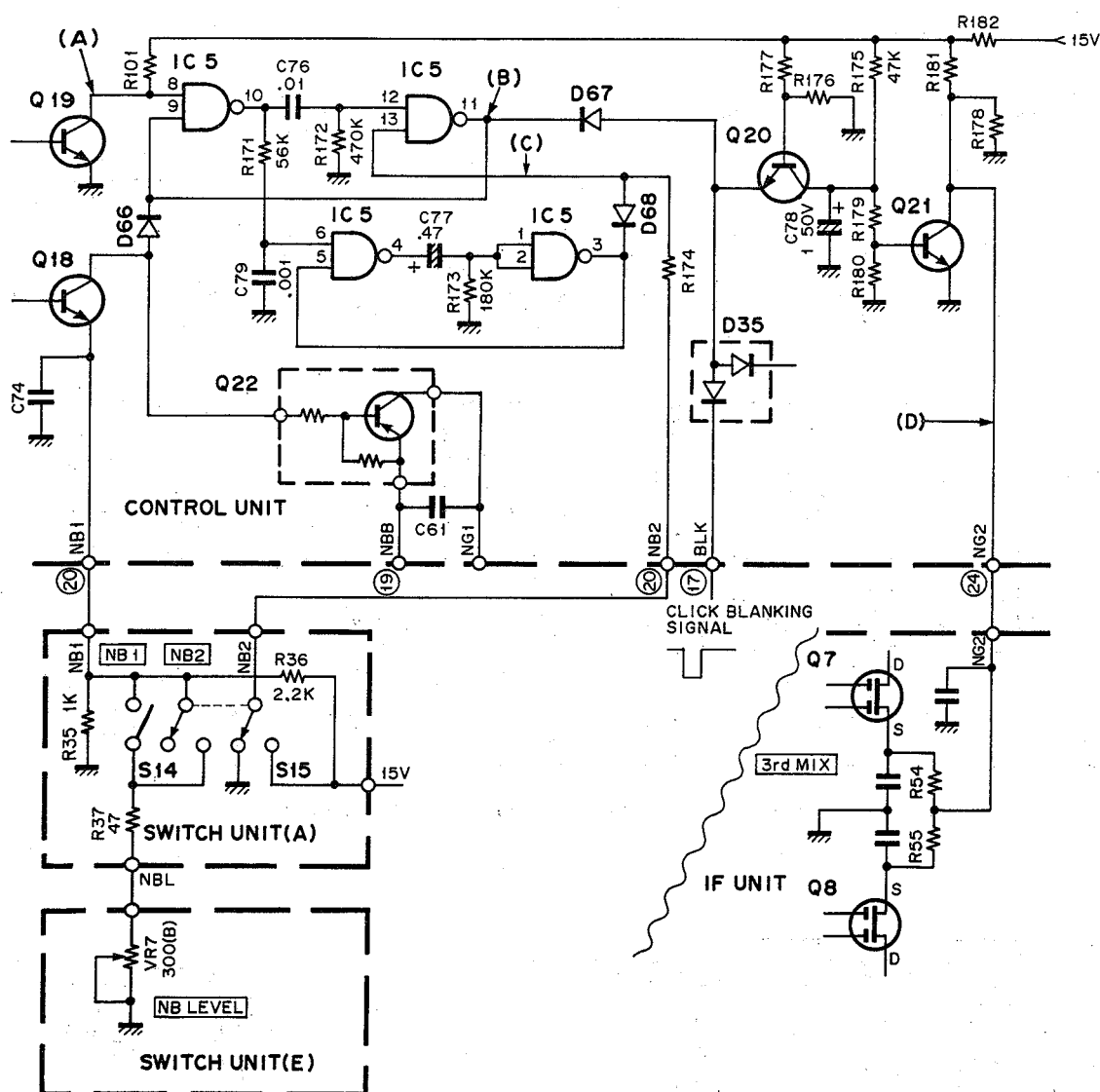


Fig. 7 NB gate control circuit

## CIRCUIT DESCRIPTION

### ● CW-VBT, SSB-SLOPE-TUNE (RF/IF and PLL/CAR unit)

**Fig. 9** gives a block diagram of the receiver related to CW-VBT (Variable Bandwidth Tuning) and SSB-SLOPE-TUNE. The principle of CW-VBT operation will be explained first. When CAR1 and CAR2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR1 frequency is shifted by  $\Delta f_1$ , the overall IF response curve shifts to that at "B". The circuit is designed so the CAR1 signal lowers the VCO frequency  $f_L$  by  $\Delta f_1$ . In this case, the IF bandwidth is fully opened, or normal. When the frequency of CAR2 is lowered by  $\Delta f_2$ , only the second IF filter of 8.8MHz band shifts to position "C". This may be interpreted that IF shift is achieved by CAR1 and the composite bandwidth is narrowed by CAR2. In the TS-940, CAR1 and CAR2 frequencies are generated by the

PLL circuit and controlled by the microprocessor, and the amount of change  $\Delta f_1$  and  $\Delta f_2$  is digitally tracked, allowing only the bandwidth to narrow without changing the center frequency of the composite passband. This is the function of CW-VBT.

Next, the operating principle of SSB-SLOPE-TUNE is explained. Designed so the relation between the frequency changes of CAR1 and CAR2 becomes  $\Delta f_2 = \Delta f_1$ , the composite passband can be varied only on the left in **Fig. 10**. If the CAR1 frequency is fixed and the CAR2 frequency is lowered by  $\Delta f_2$ , it is possible to vary only the right of the composite passband.

The SSB-SLOPE-TUNE enables these operations independently, using two controls.

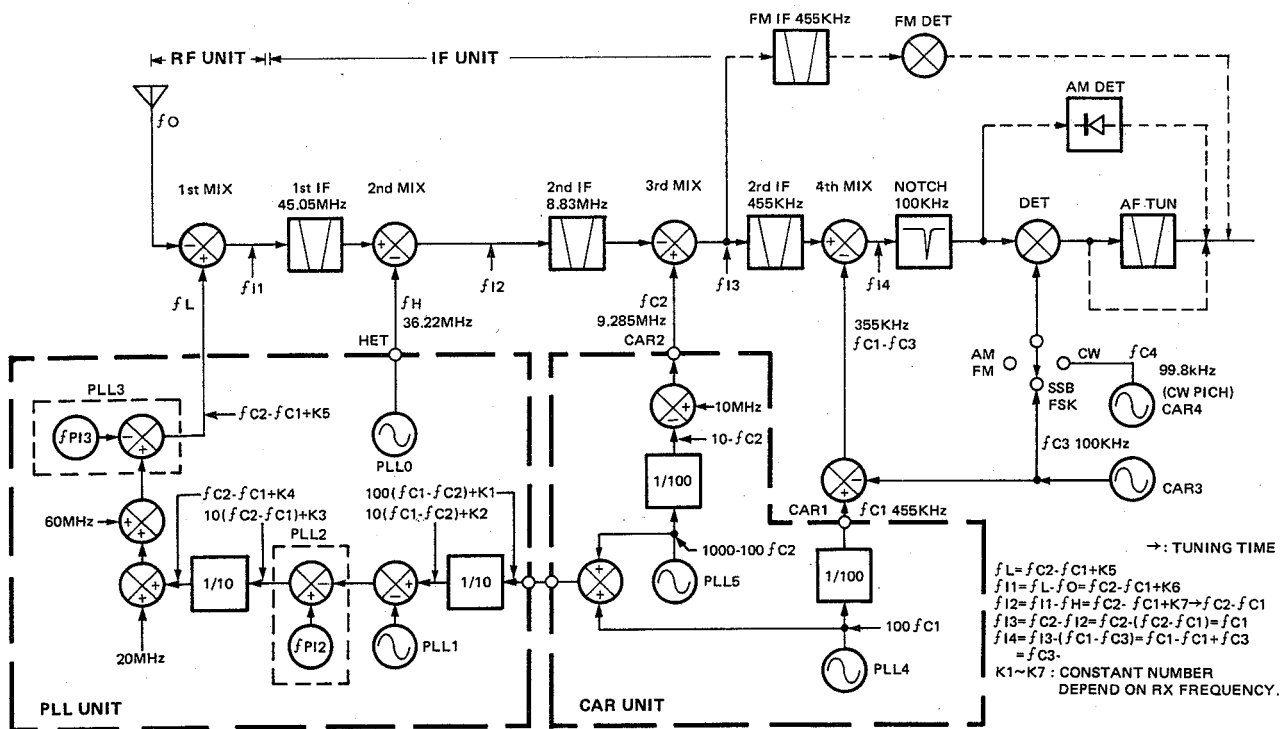


Fig. 9-A RX configuration normal (wide) response

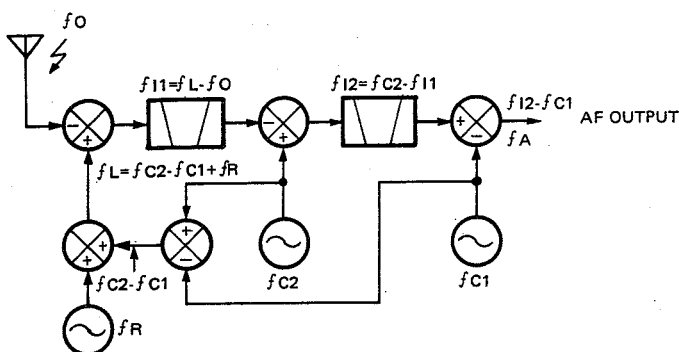


Fig. 9-B

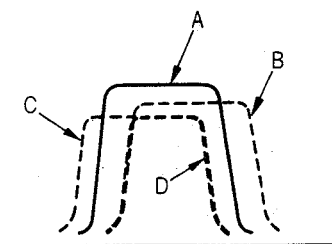


Fig. 9-C CAR2 shifted

## CIRCUIT DESCRIPTION

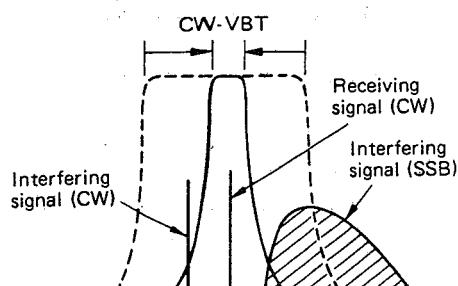


Fig. 9-D CW-VBT

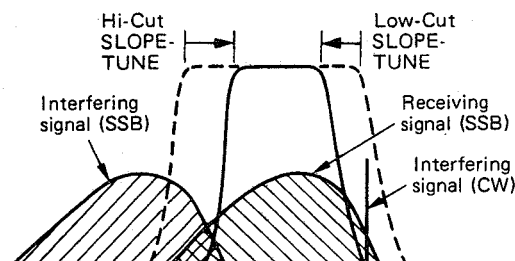


Fig. 9-E SSB-slope tune

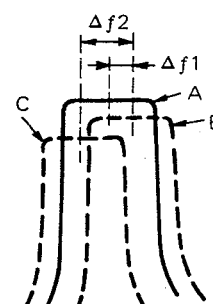


Fig. 10 VCO to bandwidth relationship

### ● Notch filter (provided in the IF unit)

This is a bridge T filter composed of L, C and R elements, which is inserted between the fourth receiver mixer and the 100kHz IF amplifier Q13. It varies the voltage applied to the cathode of varicap diode D38, thereby changing the resonant frequency. The notch filter functions in all modes except FM.

### ● AF-TUNE (provided on the IF unit)

This is an active filter using IC12, which is inserted between the SSB/CW product detector and AF pre-amplifier Q29. The frequency of this filter is over 800 ( $\pm 400$ )Hz and functions only in the CW mode. When the AF-TUNE switch is off, the audio signal is bypassed by diode D63.

## Transmitter

The audio signal from the microphone is applied to the IF unit MIC terminal and is preamplified by Q36 : 2SC2459. The output is split to the MIC GAIN control (on the front panel), the FM MIC GAIN control (on the top panel) and VOX circuit in the SSB and AM modes. The SSB signal channel is returned to the IF unit, amplified by IC3 : TA7140P and applied to balanced modulator D73 : ND487R1-3R. A diode switch is provided at the input of IC3, which selects the audio signal in the SSB and AM mode, and the AFSK signal (2.2936kHz/2.1277kHz) from the PLL unit in the FSK mode. Balanced modulator D73 is constructed as a package containing four Schottky diodes of matched characteristics, which provides stable modulation characteristic against varying operating conditions such as temperature fluctuation. The 455kHz DSB (Double Side Band) signal from D73 is converted to SSB by filter CF1 (or CF2 in the AM mode), which is shared by the third receiver IF filter after passing through the buffer amplifier Q37 : 3SK73.

The filter output runs through buffer amplifier Q39 : 2SC2458 and is then applied to the RF speech processor circuit Q40 : 2SC2458, IC4 : TA7302P and Q43 : 3SK73. When the processor is off, the signal is applied directly to the first transmitter mixer Q44 and Q45 : 3SK73 via diode switch D78 and D79 : 1S1587. In FSK mode, even if the processor switch is off, approx. 10dB compression is automatically applied. This effectively suppresses any level difference between MARK and SPACE in AFSK. Note, however, that the compression meter does not deflect.

In the AM mode, even if the processor switch is off, the signal runs through D78 and D79 but does not pass through the processor. The processor output signal is applied to the first transmitter mixer via diode switch D83. Here, the audio signal is mixed with the CAR2 signal (9.285MHz) and converted to 8.83MHz. The 8.83MHz signal runs through SSB filter XF2 (a wide band filter L37, L38 or optional YK-88A-1 in AM mode) shared by the second receiver IF filter, where any aplatler component which may be generated in the speech processor is eliminated.

The signal is then applied to the transmitter IF amplifier Q48 : 3SK73. However, in CW and FM modes or during auto antenna tuning, the CAR0 signal is applied to Q48 via buffer amplifier Q46 : 3SK73. Therefore, in these modes, since the transmitter signal does not pass through the narrow band filter, full CW break-in operation is enabled. ALC is applied to transmitter IF amplifier Q48, and a part of its output is supplied from the MON terminal to the monitor circuit on the Control unit via buffer amplifier Q49 : 2SC2787.

The transmitter signal is then applied to the second transmitter mixer Q50 and Q51 : 3SK73, where it is mixed with the HET signal (36.22MHz), yielding a TIF signal at 45.05 MHz, whose output is connected to the RF unit. In the RF unit, the signal is mixed with the VCO signal in the third transmitter mixer Q1 and Q2 : 3SK73, providing the final transmitter frequency.

## CIRCUIT DESCRIPTION

Any unwanted components in this signal are eliminated in the transmitter BPF (1.8–30MHz), amplified by wideband amplifier Q3 : 3SK73, Q4 : 2SC1907 and Q5 : 2SC1973 and supplied from the DRV terminal to the Final unit as the drive-level output. This drive output is automatically disconnected from the Final unit input if a connection is plugged into the transverter connector. The signal applied to the Final unit is amplified by wideband drivers Q2, Q3 : MRF485 and finals Q4, Q5 : MRF422.

The output of the Final unit passes through the Filter unit where unwanted the higher harmonic component element is eliminated. The Filter unit divides the transmitter frequency range into bands, and each LPF is automatically selected by TX LPF information (LP0–LP2) supplied from the Digital A unit.

After passing through the Filter unit, the transmitter output runs through the AT (optional) unit, the transmitter/receiver selector circuit and then is connected to the ANT terminal on the rear panel.

Transmit freq' (MHz)	TX-LPF selected data			LPF
	LP2	LP1	LP0	
1.9	0	0	1	A
3.5	0	1	1	B
7	1	1	1	C
10	1	0	1	D
14	1	1	0	E
18	1	0	0	F
21	1	0	0	F
24.5	0	1	0	G
28	0	1	0	G

Table 18 Selection of TX LPF

## Additional transmitter circuits

- Final cooling fan driving circuit (provided on the Filter unit)

First, the final heat sink temperature is detected by thermistor TH1 provided on the Final unit. If the heat sink temperature rises to approx. 50°C, comparator IC1A functions (high level) to start cooling fan operation and Q7 turns on. At this time, the temperature protection comparator IC1B is low level, and Q8 is on. Therefore, approx. 10V (D11 : Zener voltage 5.1V, D13 : Zener voltage 4.3V, Q8 : VCF SAT 0.1–0.3V) appears at the MOT terminal and drives the fan motor.

This circuit is designed with hysteresis so the fan stops when the Final heat sink temperature falls to approx. 45°C.

- Final temperature protection circuit (provided on the Filter unit)

If the Final heat sink temperature rises to approx. 90°C, temperature protection comparator IC1B on the Filter unit switches from low to high level, and Q8 turns off. Therefore, approx. 12V, the total voltage of zener diode D11, variable resistor D12 (1.7V) and zener diode D13, is generated at the MOT terminal, the motor speed is increased and the final heat sink is cooled more rapidly.

At the same time, the high level signal from IC1B is sent to the Control unit via the BTP terminal to stop transmission and forcibly sets the receive mode.

When the sink temperature falls to approx. 65–70°C, this circuit is released and transmit mode is again enabled. thereafter, the fan is driven by the cooling fan driving circuit until the heat sink temperature further lowers to approx. 45°C.

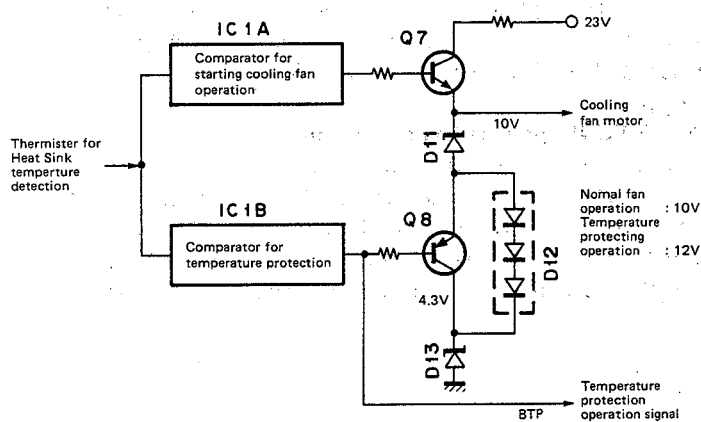


Fig. 11 Fan and temperature protection

- ALC circuit (provided on the Control unit)

Forward wave voltage VSF detected in the Filter unit is applied to the base of Q36 in the Control unit. Q36 and Q37 are differential amplifiers. When the VSF voltage rises, the collector voltage of Q37 rises and that of Q35 lowers. Therefore, the gate voltage of Q33 lowers and the base and emitter voltages of Q34 lower. As a result, the ALC line voltage decreases due to D46 and Q34 being connected to the ALC line, thus controlling TX RF output power.



## CIRCUIT DESCRIPTION

The drain (voltage) of Q33 operates the ALC meter. Trim controls VR8, VR9 are the internal set points for the ALC meter circuit. The TBK line voltage delivers the keying signal through active low-pass filter Q32 where any key click components are eliminated, its output becomes ALC

voltage, and this is supplied to the ALC line. As seen from this description, the ALC voltage is used not only for controlling transmitter output power, but is also for keying the output in the CW operating mode.

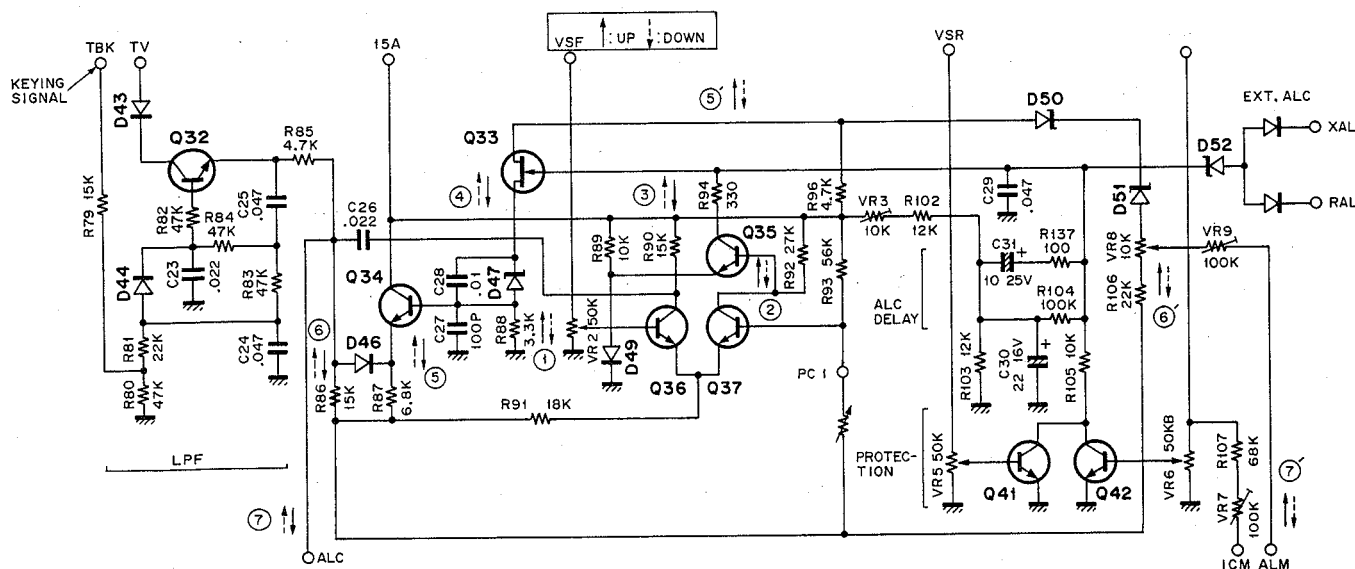


Fig. 12 ALC circuit

### ● Power control

The power control provided on the front panel permits control of transmitter output from full power to 10W or less. The power control is a 2-ganged potentiometer, which controls the first gate voltage of broad band amplifier Q3 in the RF unit to vary the voltage gain. Secondly, it controls the base voltage of ALC circuit differential amplifier Q37 in the Control unit and therefore the threshold level of the ALC amplifier. Therefore, when the Power control is varied, ALC is held nearly constant at any setting.

If the auto antenna tuner were to be used with the transmitter output set to minimum (10W or less) by the Power control, the RF output power might be too low to detect the necessary controlling current and voltage and normal tune operation would not be possible.

To solve this problem, the TS-940 is designed to automatically switch FET Q3 gate voltage the RF unit voltage amplifier to its maximum value, regardless of the power control, set position, and at the same time, switch the base voltage of Q37 to provide a 50W RF output level to properly operate the auto tuner.

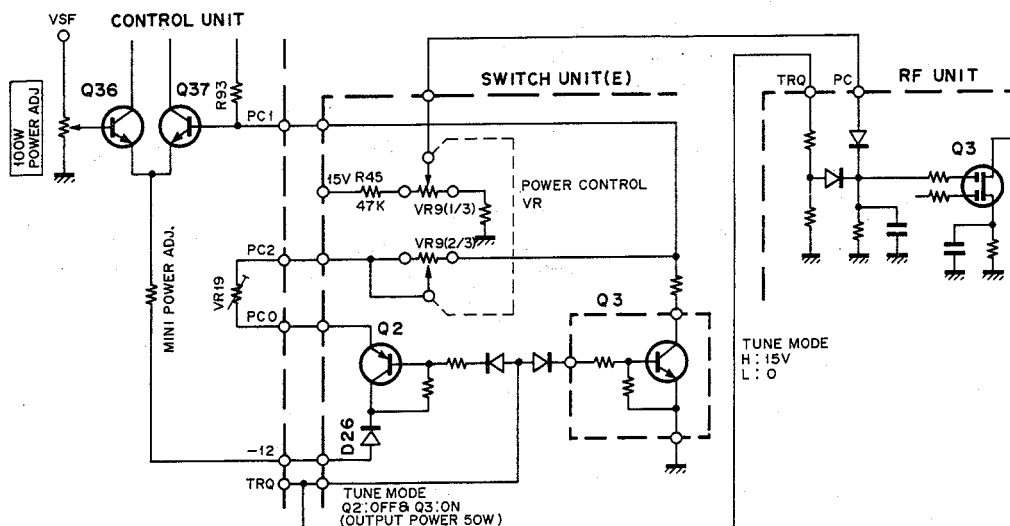


Fig. 13 Power control circuit

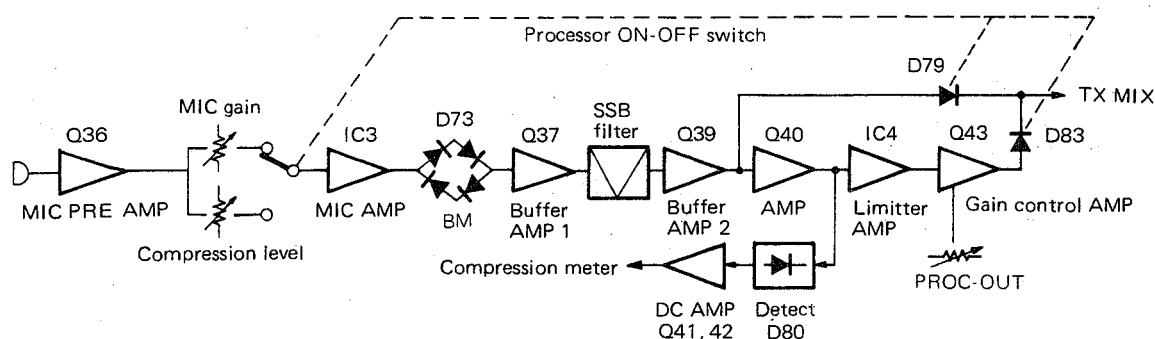
## CIRCUIT DESCRIPTION

### ● Speech processor (provided on the IF unit)

The block diagram is shown in **Fig.14**. An input signal runs through 455kHz filter CF1 and buffer Q39. The signal is then amplified by Q40 and applied to detector D80 and limiter amplifier IC4. The detector output is applied to DC amplifier Q41 and Q42, where it is compressed logarithmically. The output signal is coupled to the compression meter, indicating the compression level. The signal applied to IC4 is held constant in output level regardless of the

input level. The signal is then applied to the first transmitter mixer via gain control amplifier Q43.

When the processor is off, the signal is bypassed by switching diodes D78 and D79. In FSK mode, even if the processor is off, approximately load compression is applied to level the amplitude change between the mark and space signals. In the FSK mode, the ALC level is adjusted by the processor OUT control



**Fig. 14 Speech processor block diagram**

### ● Monitor circuit (provided on the Control unit)

#### SSB/FSK mode

The signal taken from the drain of the second transmitter IF amplifier Q48 on the IF unit is amplified by Q49 and applied to the MON terminal. The output signal from the MON terminal is applied to IC16:  $\mu$ PC1037H via the Control unit buffer Q58.

In IC16, the CAR0 (8.83MHz) is injected for signal product detection. This is amplified by Q59 and applied to the audio power amplifier IC15 via the monitor level internal adjustment control VR13.

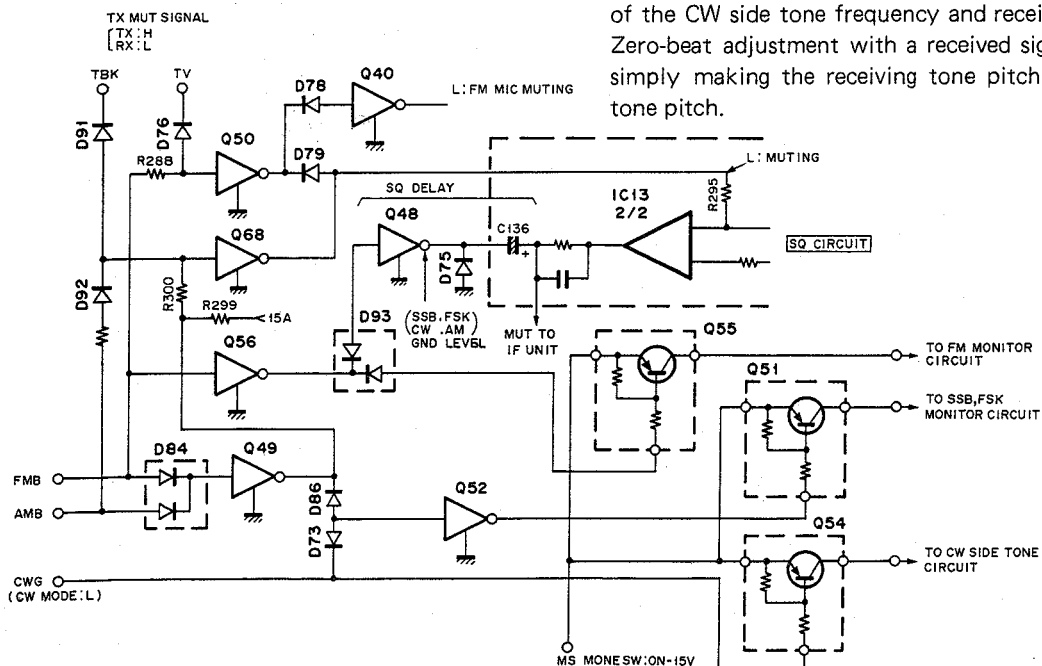
#### FM mode

The output of the FM microphone amplifier Q64, Q65 and IC14 is amplified by Q62 and supplied to VR13, as in the SSB/FSK mode.

#### CW mode

#### Side tone circuit (provided on the Control unit)

CAR3 and CAR4 signals of 100kHz and 99.2kHz are product detected by Q57 to generate an audio beat at 800Hz. Q57 is switched by the STK line through diode D71 and turned on when the key is closed, generating side tone. The 99.2kHz CAR4 signal is frequency controlled by the pitch control on the front panel, allowing simultaneous variation of the CW side tone frequency and receiver CW tone pitch. Zero-beat adjustment with a received signal is achieved by simply making the receiving tone pitch equal to the side tone pitch.



**Fig. 15 Monitor, audio muting and FM mic muting circuit**

## CIRCUIT DESCRIPTION

### • SWR automatic arithmetic circuit (provided on the Control unit)

The automatic SWR arithmetic computation circuit has been adopted from the original circuit first used in the TS-930. The forward wave voltage VSF and reflected wave voltage VSR from the Filter unit are applied to an analog arithmetic circuit on the Control unit, output from IC9, pin 1 as VSR/VSF level, and indicated by the SWR meter. IC9 contains an integrating circuit and V-I converter for the auto tuner, while IC10 contains a triangular wave generator and voltage comparator. Q43 and Q44 are used for switching the forward and reflected wave input signals at an equal duty ratio.

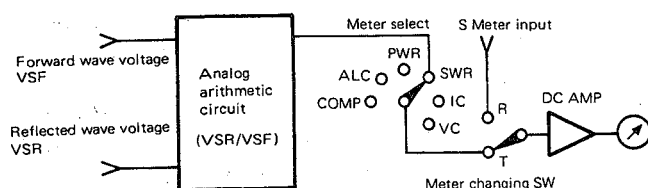


Fig. 16 SWR meter circuit

The VSF voltage is compared with a REF voltage on IC9 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC10 pin 1 is a triangular reference signal and is mixed with the voltage from IC9 pin 14. Changes in the output of IC9 pin 14 affect the reference level of this triangular wave. IC10 computes the change and sends a square wave signal, whose pulse width and spacing are proportional to the change, to control conduction of switching transistors Q43, Q44. See Fig. 17.

The voltage at IC9 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-940 control purposes. VR18 is an SWR meter adjust for initial setup only.

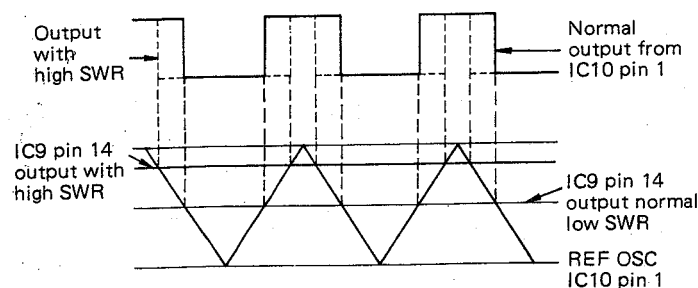


Fig.17

### • Timing circuit

The TS-940 has five kinds of timing signals for switching between transmission and reception; TV, RV, TR, TBK and ALC. Fig. 18 shows the timing relationship between these signals. This is the timing chart for SSB, MF, FSK and CW full break-in keying. The timing charts for CW keying in the CW semi-break-in and standby modes are shown in Fig. 19, (a) and (b).

TV and RV are the supply voltage to be applied to each of the various transmitter and receiver channel circuits. A pause of approx. 3ms is designed between the switching of each voltage.

The transient state of each circuit stabilizes within this period. The TR live information the PLL channel of the transmit/receive status, and is used to switch transmitter and receiver frequencies during "cross band" mode operation. the transient state of this signal is also stabilized within the 3ms pause time.

TBK is the keying signal in the CW operating mode. This signal is allowed to pass through the active low filter to eliminate any key click component and then, the output is used to generate ALC voltage. Therefore, ALC voltage is used not only for controlling the transmitter output, but also for output keying in the CW mode.

In modes other than CW, output keying is unnecessary, but the timing remains the same. Fig. 19, (a) and (b) give the timing charts for CW semi-break-in operation and CW mode with just the standby switch. If Fig. 19, the timing of RV, TR, etc. are omitted, as they are the same as those in Fig. 18.

The trailing edge of TV is approx. 6ms after that of TBK. During this period, the transmitter output breaks together with ALC voltage. TB and RB are the transmitter and receiver channel bias voltage; the timing is synchronized with the TV signal. RB is inverted. Fig. 20 gives the basic block diagram, to generate each of these timing signal previously discussed.

Fig. 21 shows the operating timing chart in this configuration. The actual operation of the timing chart will now be described. (See Fig. 22 "Block diagram")

This circuit is operated by the keying input, standby switch (PTT) input, VOX input, ANTI-VOX input, etc. In the block diagram (Fig. 22), STBY SW Gate 3 (IC1 4/4) opens (D30, goes Hi) only at keying by the standby switch in CW mode. Operation by the standby switch in modes other than CW makes transistor Q6 turn off as D26 drops to GND in send mode. Thus, a high voltage is applied to inverter IC3 2/6 via D31. (In CW mode, since the cathode of D27 becomes low, a high voltage is not applied to D31.)

## CIRCUIT DESCRIPTION

When the VOX is on, a high voltage is applied to inverter IC3 2/6 from the one-shot multivibrator via D4. (The VOX circuit is explained in a following section.) The output of inverter IC3 2/6 (pin 6) goes low, the cathode of D14 becomes low, and TR switching transistor Q7 turns off.

Thus, a high voltage is supplied to the TR terminal via D9. (Fig. 18— (A) ) (As Q7 is on in the receive mode, the TR terminal is low.)

At the same time, the RV AND gate 5 (IC4 2/3), pin 4 goes low (TX protection OFF → BTR terminal L), the output terminal, pin 6 becomes low and the RV switching circuit (Q30, Q28) turns off.

Therefore, as soon as the transistor level becomes high RV voltage level becomes low. (Fig. 18— (B) )

The output of inverter IC3 2/6 enters the delay circuit I composed of IC1 3/4, R29 and C13. The output signal delayed approx. 3ms (H level) is applied to IC1 3/4, pin 4. (Fig. 18— (C) ). This signal becomes the TBK keying signal in the CW operating mode.

When the TBK signal is applied to the YV gate IC4 3/3 (pin 13) via Q24, a TV switching signal synchronized with the leading edge of the TBK voltage is generated at pin 10 as an output. At this time, as the RV gate output (IC4 2/3, pin 6) is at low level (D21 is off), IC4 2/3, pin 12 is at high level, like the output of inverter IC3 6/6. IC4 3/3, pin 11 is usually at high level when the PLL is in the lock states.

When this signal (IC3 3/3, pin 10) is applied to the TV switching circuit, a TV voltage is generated. (See Fig. 22, "Block diagram".)

Based on the TV voltage, an in-phase TB voltage and inverted RB voltage are generated. (Fig. 18— (D) and (E) ). The leading edge (RX → TX) of the timing circuit will now be discussed. When the key is up in the CW operating mode, as the output (pin 13) of the STBY switch gate 3 changes from high to low level and the output (pin 3) of gate 2 changes from low to high level, the output (pin 10) of one-shot multivibrator IC2 3/4 goes low and D4 turns off.

Since the cathode of D27 is at low level due to the CWG signal, the anode of D31 is held at low level, i.e., D4, D30 and D31 turn off. Thus, the input to inverter IC3 2/6 changes from high to low level, and the output of IC3 2/6, pin 6 changes from low to high level. When the VOX turns off during VOX operation or the standby switch is set to the REC position, the output of inverter IC3 2/6 becomes high level as in the previous narrative.

This signal is applied to the delay circuit I and after 3ms. The TBK line voltage breaks. (Fig. 18— (F) )

TBK voltage is inverted by inverter IC3 3/6, and is used to change the input signal level of BK gate 7 (IC4 1/3, pin 8) from low to high.

Since pin 2 is at high level at break-in, gate 7 changes the output level at pin 9 from low to high at the trailing edge of the TBK timing signal. During semi-break-in, since pin 2 is held low during the delay time, output pin 9 changes from a low to a high level stage after the delay. At this time, the

BK gate 7, pin 1 is high because the key is up. The BK gate 7 output signal is applied to delay circuit II and after approx. 5ms, the signal becomes low level, and D23 turns off to change the TV gate 6, pin 13 from a high to a low logic level. Therefore, the output (pin 10) of TV gate 6 changes from high to low, and the TV voltage is lowered. (Fig. 18— (G) )

At the same time, the TB voltage breaks and inversely, the RB voltage rises. (Fig. 18— (I) and (J) ) In addition, as the TV voltage being supplied from D36 to the TR line breaks at the same time, the TR voltage changes from high to low level. (Fig. 18— (H) )

Further, the output signal of delay circuit II is applied to the integrating circuit of delay circuit III, where it becomes a 3ms delayed signal, and this output changes the RV gate 5, pin 3 from a low to a high logic level. (At this time, pin 4 and pin 5 are high level.) Thus, the output of RV gate 5 changes from low to high and RV voltage rises. (Fig. 18— (K) ) When a temperature protection signal or band protection signal are applied from the filter unit to the BTP terminal, the RV switching circuit functions via D21 and generates RV voltage. At the same time as TV gate 6, pin 12 is changed from high to low level by inverter IC3 6/6, the output signal level is also changed from high to low and the TV switching circuit turns off. Thus, TV voltage drops and the transceiver goes into the receiving state.

### • VOX, ANTI-VOX circuit (provided on the Control unit)

In Fig. 22, "Timing circuit configuration", the MIC pre-amplifier output is applied to the VXZ terminal on the Control unit via the VOX gain control, amplified by VOX amplifier Q1~Q3 and applied to the following stage R-S flip-flop (IC1 1/4, pin 13). On the other hand, the AF output signal (SP2 signal) from the speaker is applied to ANTI-VOX amplifier Q10, Q11 to be DC rectification, and this output is applied the R-S flip-flop IC1 2/4, pin 9.

By using this logic function, the faster input either VOX or ANTI-VOX, is given priority. When the VOX input is given priority, a signal pulse is applied to VOX gate 1 (IC2 1/4, pin 12) and the gate is opened. However, gate 1, pin 13 is high when the VOX switch is on in SSB, FM or AM mode. When ANTI-VOX is given priority, VOX gate 1 (IC2 1/4, pin 12) is low and the gate is closed.

In CW mode, the STK terminal signal (low at key down) is applied to VOX gate 2 (IC2 2/4, pin 2) after being switched by Q9. thus, a high level signal is applied to VOX gate 2 (IC2 2/4, pin 2) and the gate is opened when the key closed. Gate 2, pin 1 is high when the VOX switch is on in CW mode. Gate 1 or 2 signal goes through one-shot multivibrator IC2 3/4 and IC3 1/6 and enters the VOX Delay circuit composed of C9, R18 and Q4, where the VOX hold time is established. Use of this type of logic circuitry increases response the speed of the VOX and eliminates VOX/ANTI-VOX cycling.

# CIRCUIT DESCRIPTION

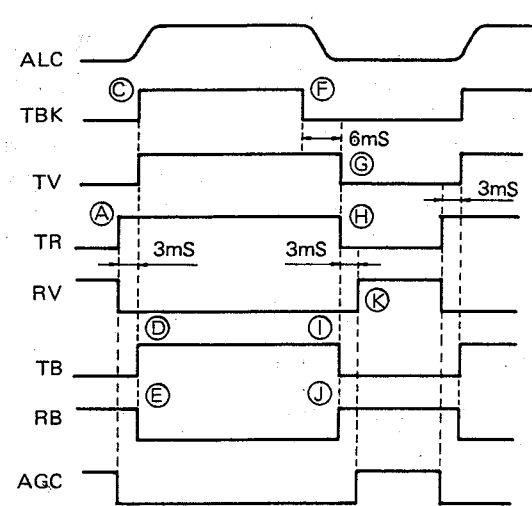
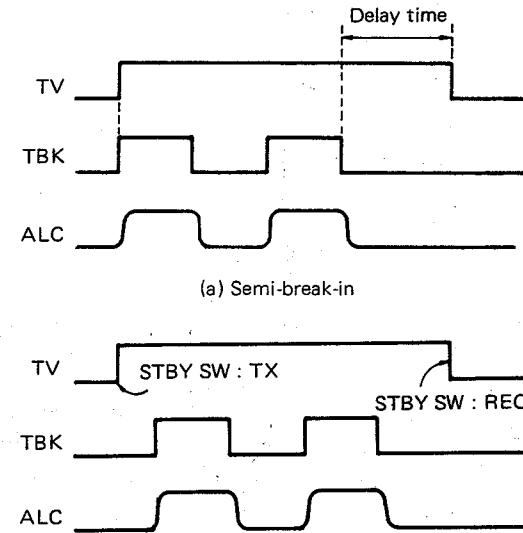


Fig. 18 T-R timing chart  
(CW full break-in, SSB, FSK and TUNE modes)



(a) Semi-break-in  
(b) CW keying when SEND SW is ON

Fig. 19 CW operation timing chart

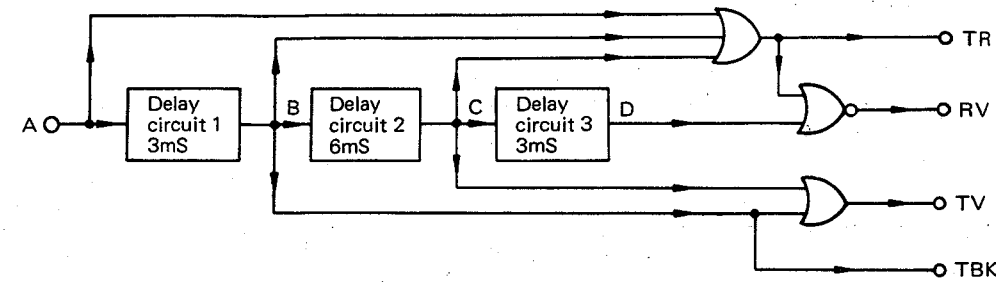


Fig. 20 Timing circuit basic block diagram

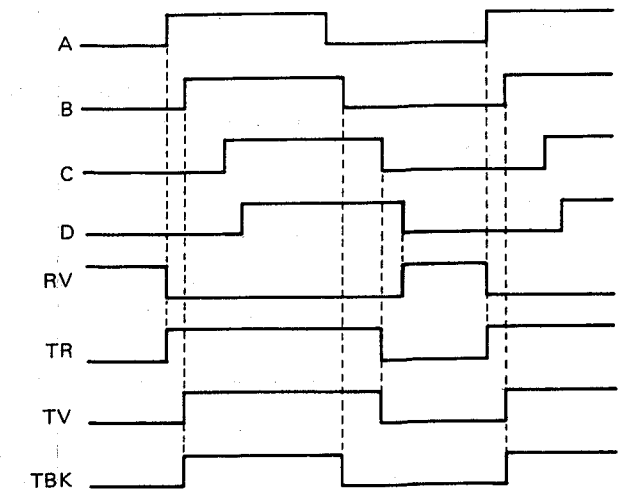


Fig. 21

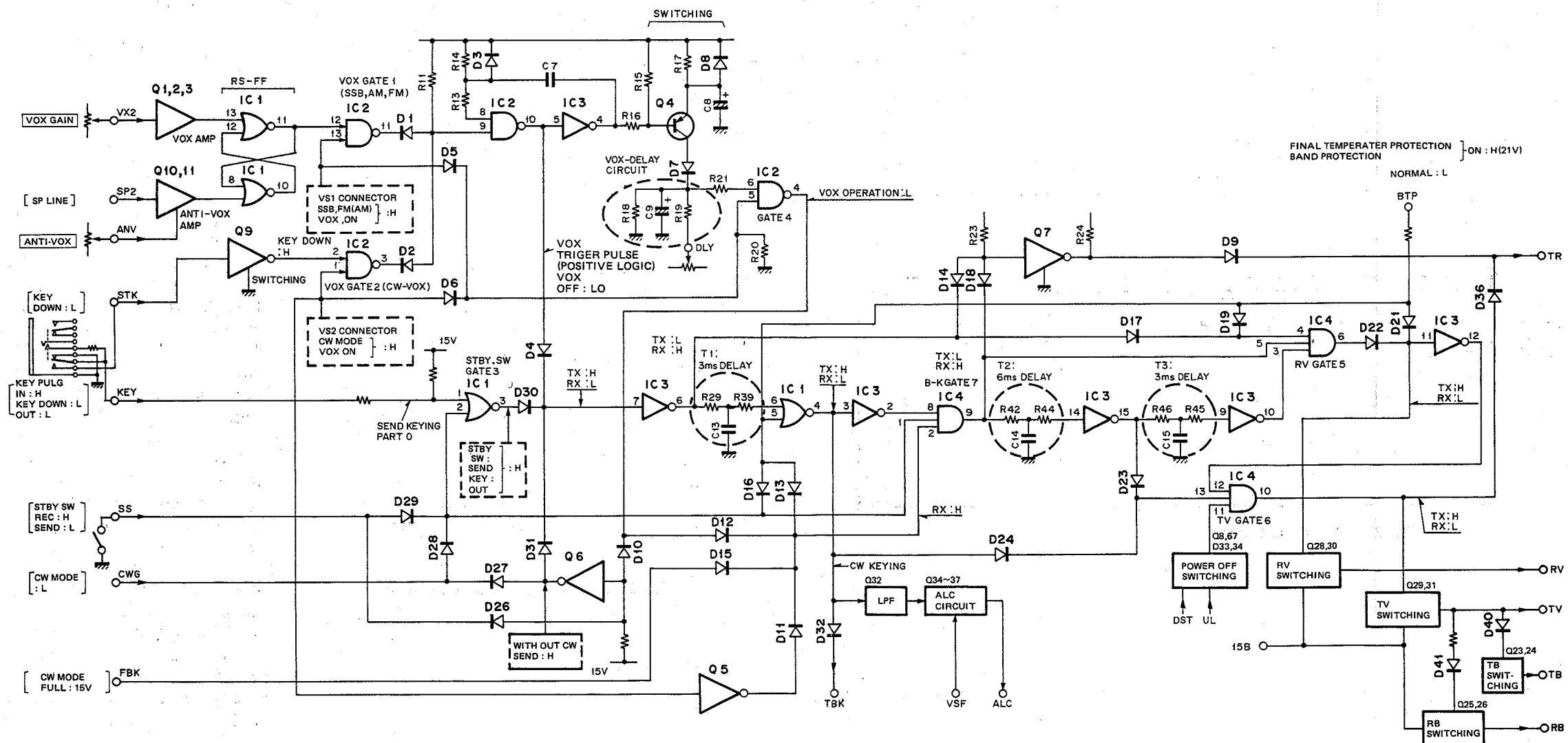


Fig. 22 Timing circuit block diagram

## CIRCUIT DESCRIPTION

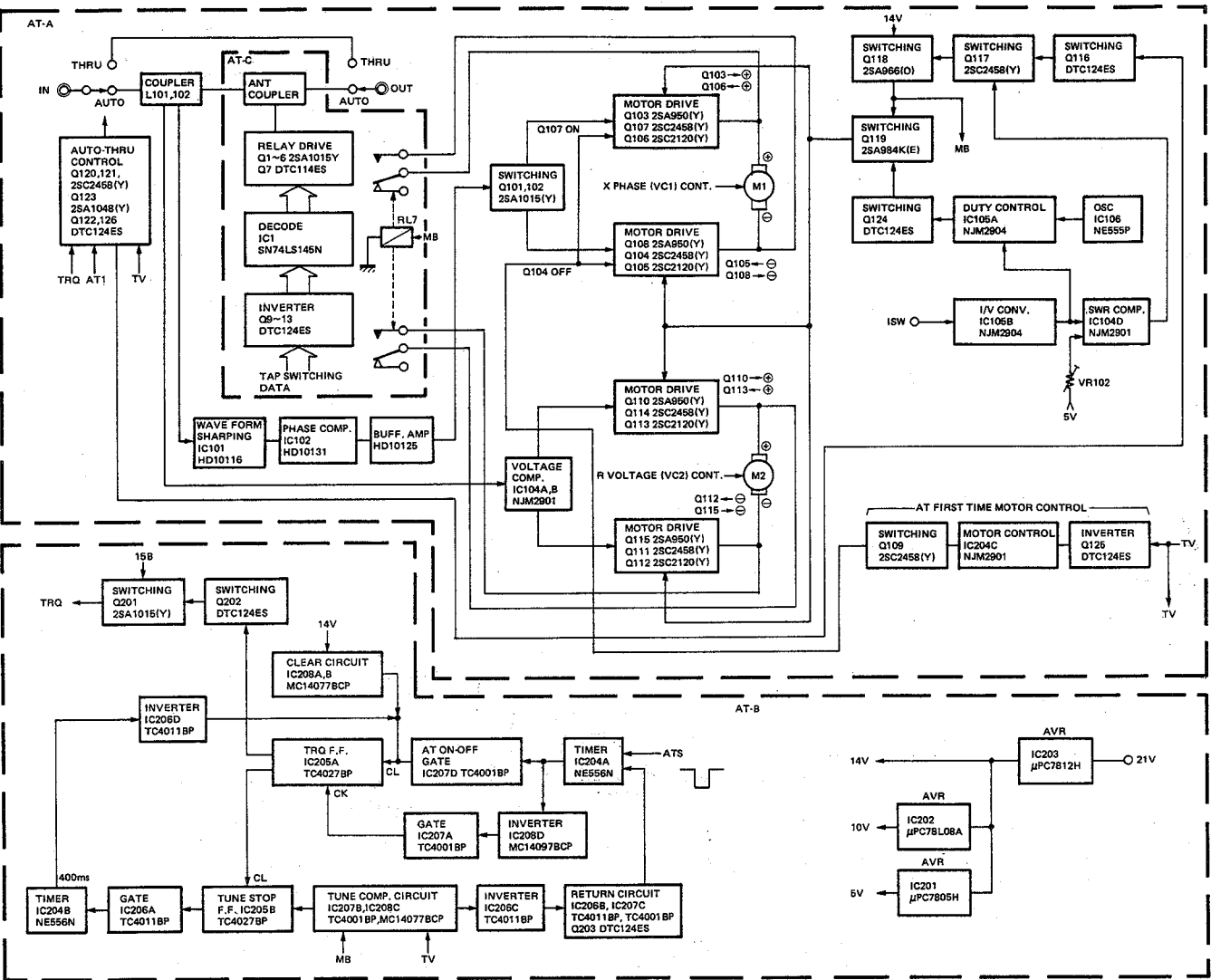
- **Antenna tuner**

The block diagram is shown in **Fig. 23**. The AT-940 operates in the 1.8–29MHz bands and is automatically adjusted so that the SWR becomes 1.2 : 1 or less. For smooth antenna tuning, the mode is stored before antenna tuning and set again after tuning. **Fig. 26** shows the antenna tuner timing chart.

The AUTO-THRU relay protective circuit (Q120, Q121,

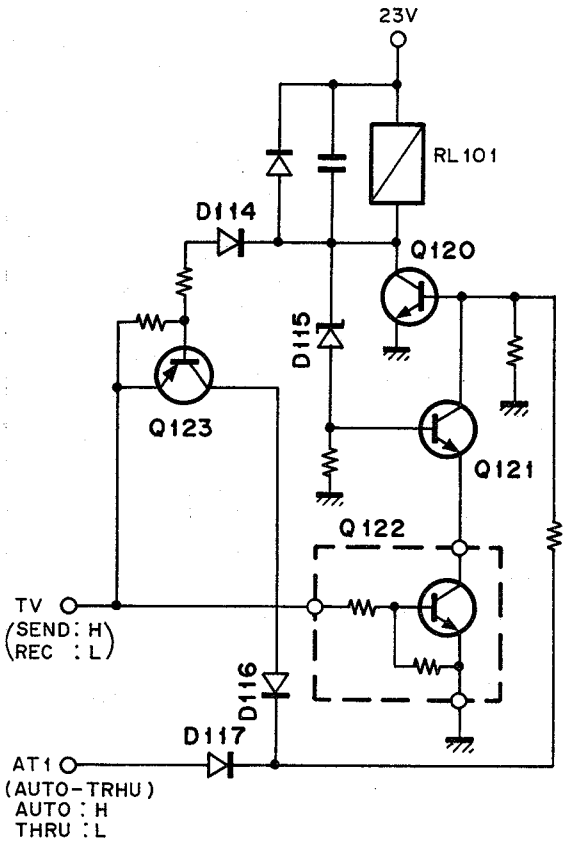
122, 123 and 126) holds the AUTO-THRU relay condition during transmission. This circuit monitors the AUTO-THRU switch condition and the TV line (Transmit-high level/receiver-low level) and allows a change in the AUTO-THRU switch to affect the relay condition only when the TS-940 is in the receiver mode.

A change in the AUTO-THRU switch during transmission change the relay only after the TS-940 returns to receive. (See **Fig. 24** "Relay protection circuit diagram.")



**Fig. 23 AT unit block diagram**

## CIRCUIT DESCRIPTION



REC	Q122 : OFF	Q120 : OFF	RL101 : OFF
	Q121 : OFF	Q123 : OFF	
↓			
AUTO-THRU	Q120 : ON		RL101 : ON
AUTO			
↓			
STBY SW	Q122 : OFF	Q123 : ON	
SEND	Q121 : OFF	Q120 : ON	RL101 : ON
↓	(Relay protection operation)		
AUTO-THRU	Q122 : OFF	Q123 : ON	
THRU	Q121 : OFF	Q120 : ON	RL101 : ON
↓			
STBY SW	Q122 : OFF	Q123 : OFF	
REC	Q121 : OFF	Q120 : OFF	RL101 : OFF
↓			
STBY SW	Q122 : ON	Q123 : OFF	
SEND	Q121 : ON	Q120 : OFF	RL101 : OFF
↓	(Relay protection operation)		
AUTO-THRU	Q122 : ON	Q123 : OFF	RL101 : OFF
AUTO	Q121 : ON	Q120 : OFF	

**Fig. 24 Relay protection circuit diagram**

To operate, the AUTO-THRU switch must be set to the AUTO position. When the ATT switch is pressed, the antenna tuner start pulse (At start pulse) of 40–50 $\mu$ s, from the digital unit A microprocessor, triggers the AT-B unit timer IC204a (pin 6) generating an approx. 3 second pulse. Through inverter IC208d and gate IC207a, this pulse clocks JK flip-flop IC205a at pin 3 so that the pin 1 output level toggles from low to high (approx. 14V). A clear pulse, generated by IC205a and b when the power switch is turned on, sets IC205a pin 1 to its initial low level. The IC205a pin 1 high level turns on Q202 and Q201 to switch approx. 15V to the TRQ terminal (AT ready signal.)

At this AT Ready state, the microprocessor sets tune mode (MODE LED goes out) and, at the same time, the power down circuit for setting the power to 50W operates (in the Control unit)

If, during the 3 second timer operation, the STBY (or mic. PTT) switch is not set to the SEND position, gate IC207d switches at the trailing edge of the timer and clears IC205a (pin 4). This sets the pin1 output to a low level which switches the TRQ terminal to a low level. When the TRQ terminal goes low, the microprocessor returns the radio to the original mode and the power down circuit is released.

(Fig. 26- (A) )

If during this 3 second period, the STBY switch is set to the send position, the TV line goes high at IC207d input pin 13.

The gate closes and the IC205a pin 1 output is held high. At that time, the antenna tuner circuit starts tuning. When tuning is finished, the capacitor variable antenna coupler motor stops. This state is monitored at the MB terminal and JK flip-flop : IC205b is toggles to a high level by the gates IC208c and IC207b.

This flip-flop is in the clear state when the AT Ready signal is not generated. Gate IC206a detect the leading edge of this JK flip-flop signal and triggers another timer (IC204b). IC206d detects the trailing edge of this approx. 400ms pulse and clears IC205a at pin 4.

This starts the sequence of the TRQ terminal switching to a low level, the microprocessor restoring the mode, the power down circuit being released, and completion of tuning (Fig. 26—B)

The timer IC204b works as a tuning delay circuit when a momentary rattling of the motor stop really occurs.

If the STBY switch is set to the REC position during the tuning operation, the AT Ready signal is generated for three seconds. The tuning operation is started if the STBY switch is again set to the SEND position.

The MB and TV terminals are monitored by IC206a, IC206b and IC207c and when these terminal levels are changed quickly from high to low (when the STBY switch is set to the REC position before the tuning operation is finished), the first timer (IC204a) is again triggered to operate. Therefore, when the STBY switch is held in the REC position for more than 3 seconds, the AT Ready signal goes low and the original mode is returned. (Fig. 26- ©

## CIRCUIT DESCRIPTION

The antenna tuning circuit is explained next. When the AUTO-THRU selector switch is set to the AUTO position, the ATT switch is pressed and the STBY switch is set to the SEND position, transmit power is supplied from the final via the Filter unit. It passes through the current and voltage detecting transformers (L101 and L102) which use toroidal cores. the current and voltage components are applied to IC101 (pins 9 and 13) and waveform shaped. The output signal is applied to IC102 (D type master-slave flip-flop), where the phase is compared. The output of IC102 (pin 14) runs through the buffer IC103 (pins 10 and 15) and switches the emitter coupled circuit Q101 and Q102.

The motor driving circuit Q103–Q108 is operated by this ON-OFF signal, and the variable capacitor (VC1) is rotated forward or backward by the motor M1. The current and voltage components from L101 and L102 are also applied to the voltage comparator IC104a and b (pins 6 and 4), and the output operates the motor driving circuit Q110–Q115 so that the variable capacitor (VC2) is rotated forward or backward by the motor M2 to minimize the amplitude difference.

Therefore, the phase control variable capacitor (VC1) is controlled so that the phases of current and voltage coincide with each other. The voltage control variable capacitor (VC2) is controlled so that the amplitude difference between current and voltage is minimized. (SWR1 with coincidental phases and zero amplitude difference)

VC1 and VC2 are designed to rotate independently. However, since the phase and voltage influence each other, the voltage changes as the phase is changed and the rotations of VC1 and VC2 change accordingly. Also the forward and reflected wave detected in the Filter unit are applied to the Control unit SWR arithmetic circuit, from which they are sent to the AT-A unit ISW terminal as an SWR signal.

this SWR signal is in the current mode and is converted in the AT-A unit (IC105b) to make an SWR signal of voltage mode. The signal is then applied to the SWR comparator IC104d (pin 9). The voltage equivalent to SWR 1.2 : 1 is applied to the reference voltage terminal (IC104d, pin 8) through the semi-fixed resistor. Thus, when the SWR is greater than 1.2 : 1 the IC104d output terminal (pin 14) is high and switch Q118 turns the motor voltage supply on.

The motor driving circuit is actuated. When the SWR is lowered to below 1.2 : 1 the output terminal (pin 14) of IC104d switches to low, and the switching transistors Q117 and Q118 turn off (motor stop signal), the motor driving circuit turns off and the motor stops.

High motor speed is desired for fast antenna tuning. However, this can cause the match point of SWR less than 1.2 : 1 to be overrun due to increased inertia, the capacitors reversing and tuning past the match point continuously. A slower speed prolongs the operation. Therefore, the TS-940 uses the following method to vary the speed with the SWR. That is, faster with an SWR increase, and slower with an SWR reduction.

The SWR signal sent to the SWR comparator IC104d is also sent to the variable duty motor voltage circuit (IC105a, pin 5). The variable duty circuit uses timer IC106 as a triangle wave oscillator and its output is applied comparator (IC105a, pin 6) to vary the duty of the output pulse (pin 7). (Fig. 25)

Therefore, when the SWR is higher than 5 : 1, the motor driving voltage is at 100% duty, and the motor rotates at high speed. When the SWR value is lowered to 2 : 1, the duty ratio is also lowered (50%) and the motor speed becomes low. As soon as the SWR lowers to below 1.2 : 1 and the motor driving voltage disappears, the motor brake circuit RL7 operates to immediately stop the motor rotation. The antenna coupler of the TS-940 is a T type and the tap positions from 1.8MHz to 30MHz are switched by eight relays (RL1–6 and 8). The tap switching data is given in Table 19.

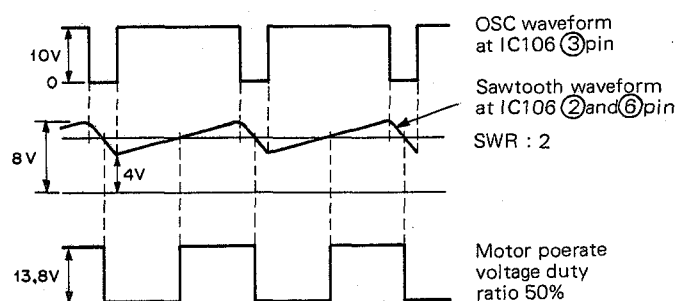


Fig. 25 Tuning motor speed control

BAND	WRC	AT0	AT1	AT2	AT3	RL1	RL2	RL3	RL4	RL5	RL6	RL8
1.8	0	1	0	1	1	○	○	○	○			
3.5	0	0	0	1	1		○	○	○			
7	0	0	1	0	1			○	○			
10	1	1	0	0	1				○			
14	0	0	0	0	1							
18	1	1	1	1	0					○		
21	0	1	1	1	0					○		
24.5	1	0	1	1	0						○	
28	0	0	1	1	0						○	○

Table 19 AT tuner band selection data

## CIRCUIT DESCRIPTION

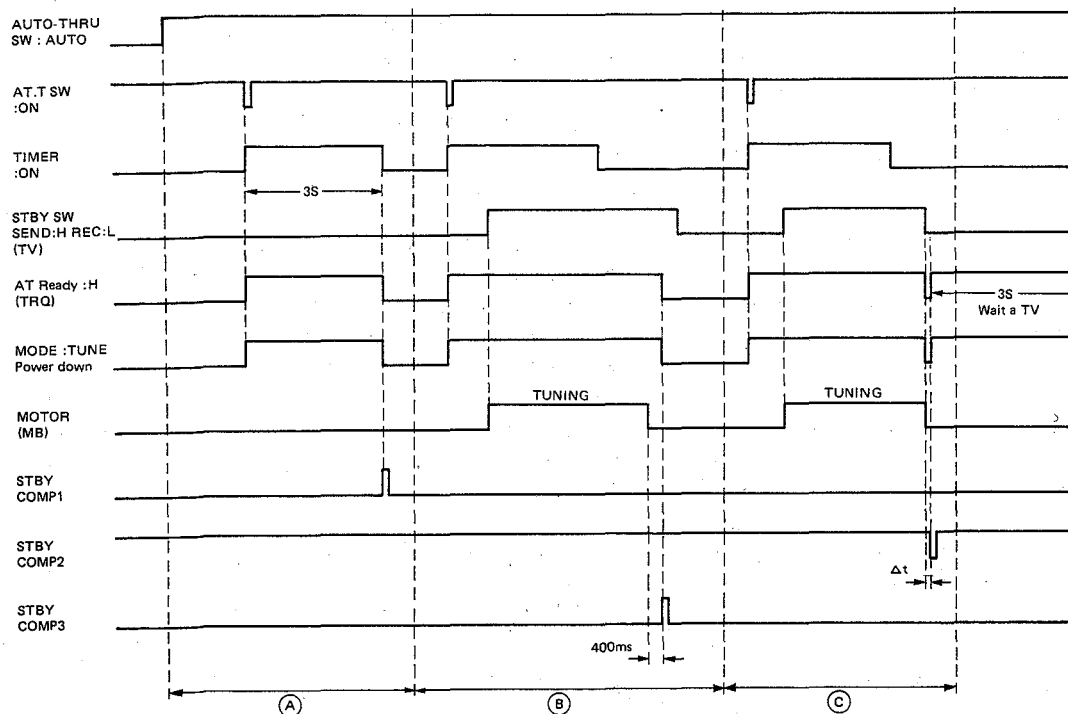
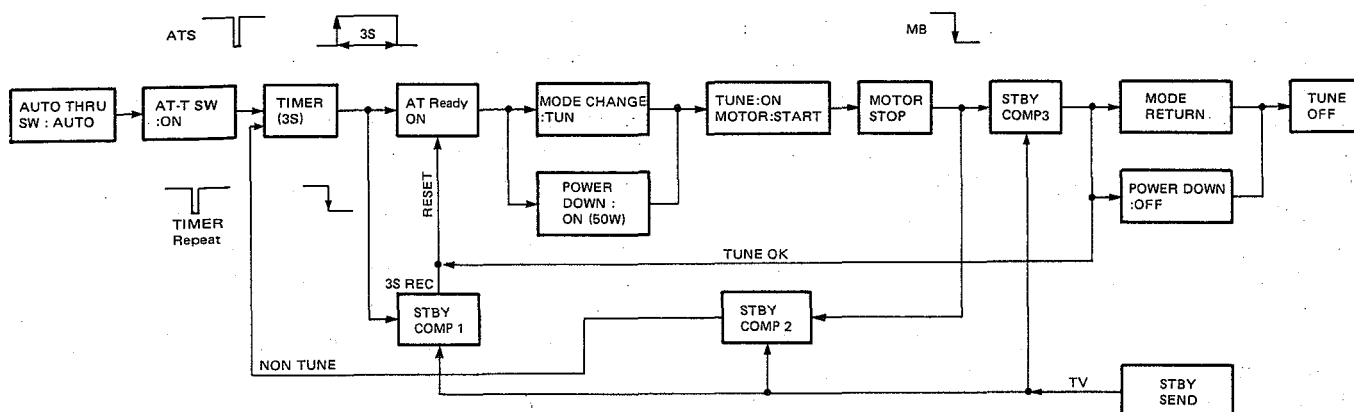


Fig. 26 AT tuner timing chart



## CIRCUIT DESCRIPTION

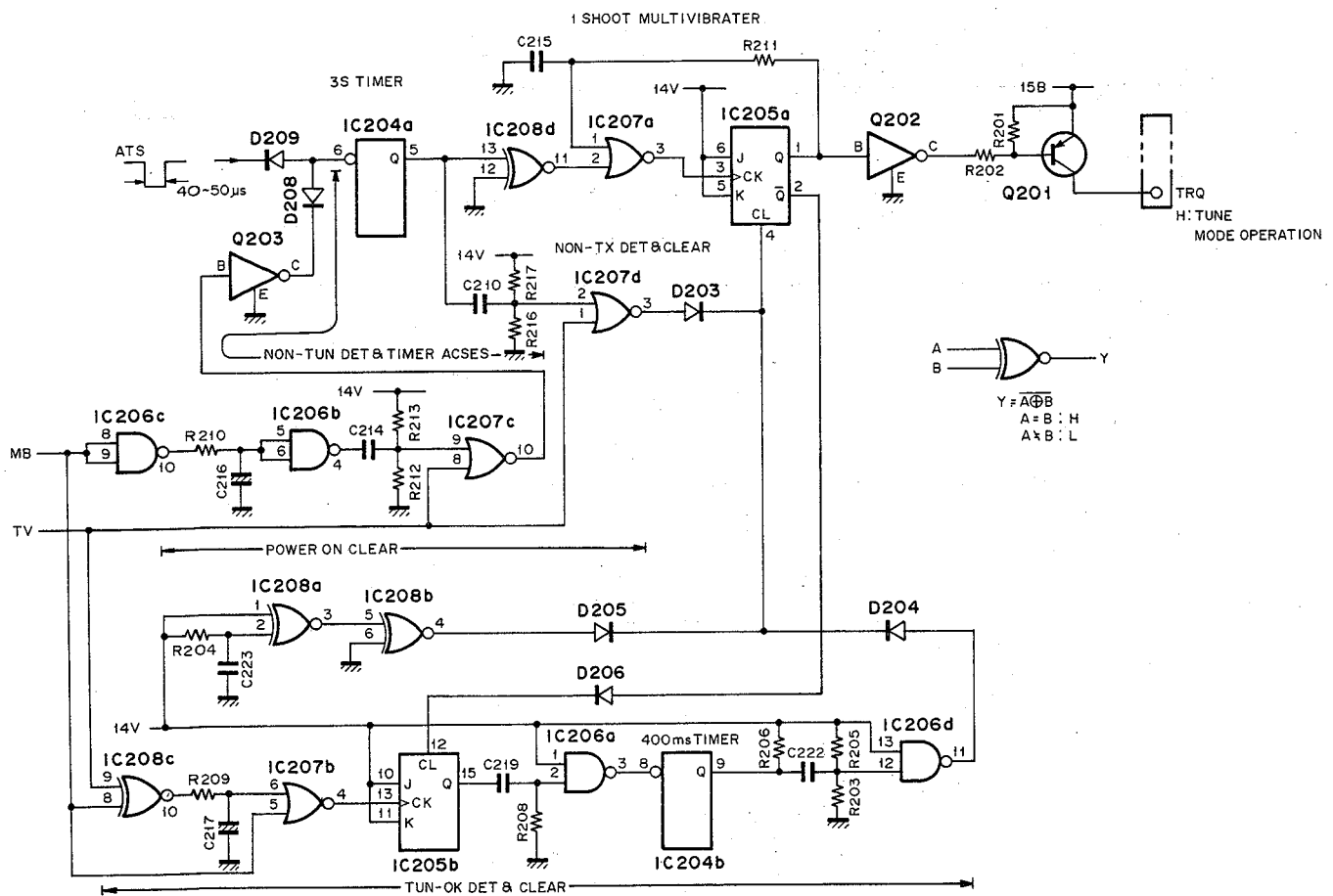


Fig. 27 AT tuner operate detection

### Digital Circuit

As shown by the block diagram in **Fig. 28**, the digital control section is the heart of the TS-940 and controls all its units. The digital section consists of the Digital A unit (X54-1830-00), Digital B unit (X54-1840-00 B/2), Digital C unit (X54-1850-00), DC-DC unit (X46-1030-00), Switch unit (X41-1600-00), Main Encoder ass'y (W02-0328-10), RIT Encoder unit (X54-1690-01) and Keyboard ass'y (S59-0433-05), a total of units. The TS-940 is capable of versatile functions, using the latest microprocessor techno-

logy. Consequently, about 50 data for the input and about 70 data for the output are handled, requiring an input/output function with much greater capacity than conventional models. To meet this requirement, the microprocessor has an 8-bit multichip construction designed to minimize the number of ICs used: the input/output uses a series of three I/O control ICs 8255 and three LC7800 (Sanyo) are used for multiplexing the input signal for the input data. Separate descriptions for each unit now follow.

## CIRCUIT DESCRIPTION

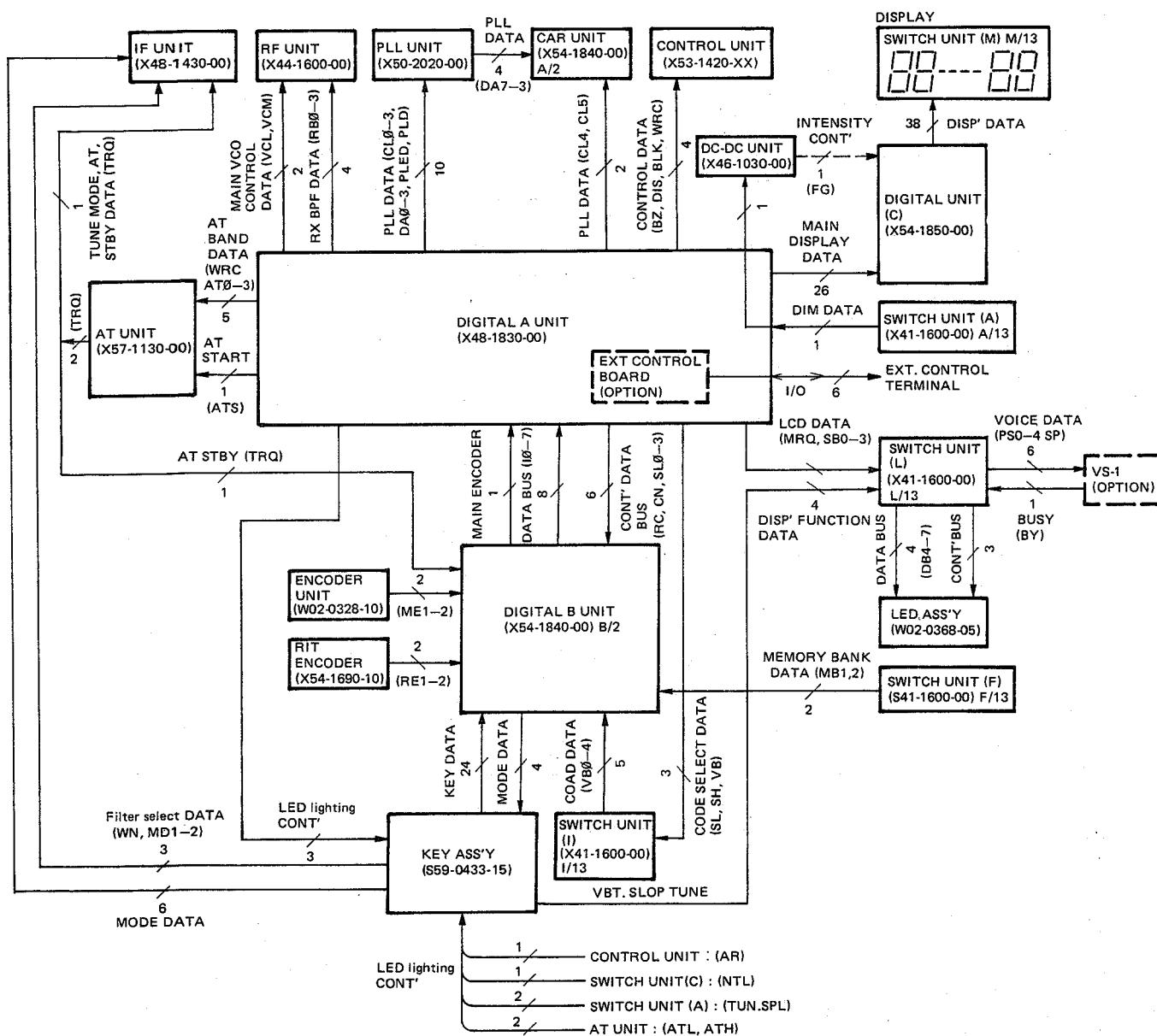


Fig. 28 Digital control block diagram

## 1) Digital B unit

This unit performs multiplexing of the input, waveform shaping of encoder pulses and detection of AT In/Through (detection of the presence of the AT unit in export models.) The input SW data in the Digital B unit goes to ICs 109, 110 and 111, selected by the port select signal from the Digital A unit, and supplied to the Digital A unit.

As with the TS-930, two optical encoders, for the main VFO and for RIT, are provided. Each converts one

dial rotation into pulses and shapes the waveform. In the main encoder, 250 pulses are converted to 1000 pulses; one rotation corresponds to the encoder signal of 10kHz with a resolution of 10Hz. In the fast tuning mode with more than 2 or 3 rotations per second, the variation of frequency progressively increases thanks to a "speed-up" function. (Main encoder ICs 101, 102, 103, 2/4, IC7. RIT encoder ICs 104, 105, 106, 2/4, 107.)

# CIRCUIT DESCRIPTION

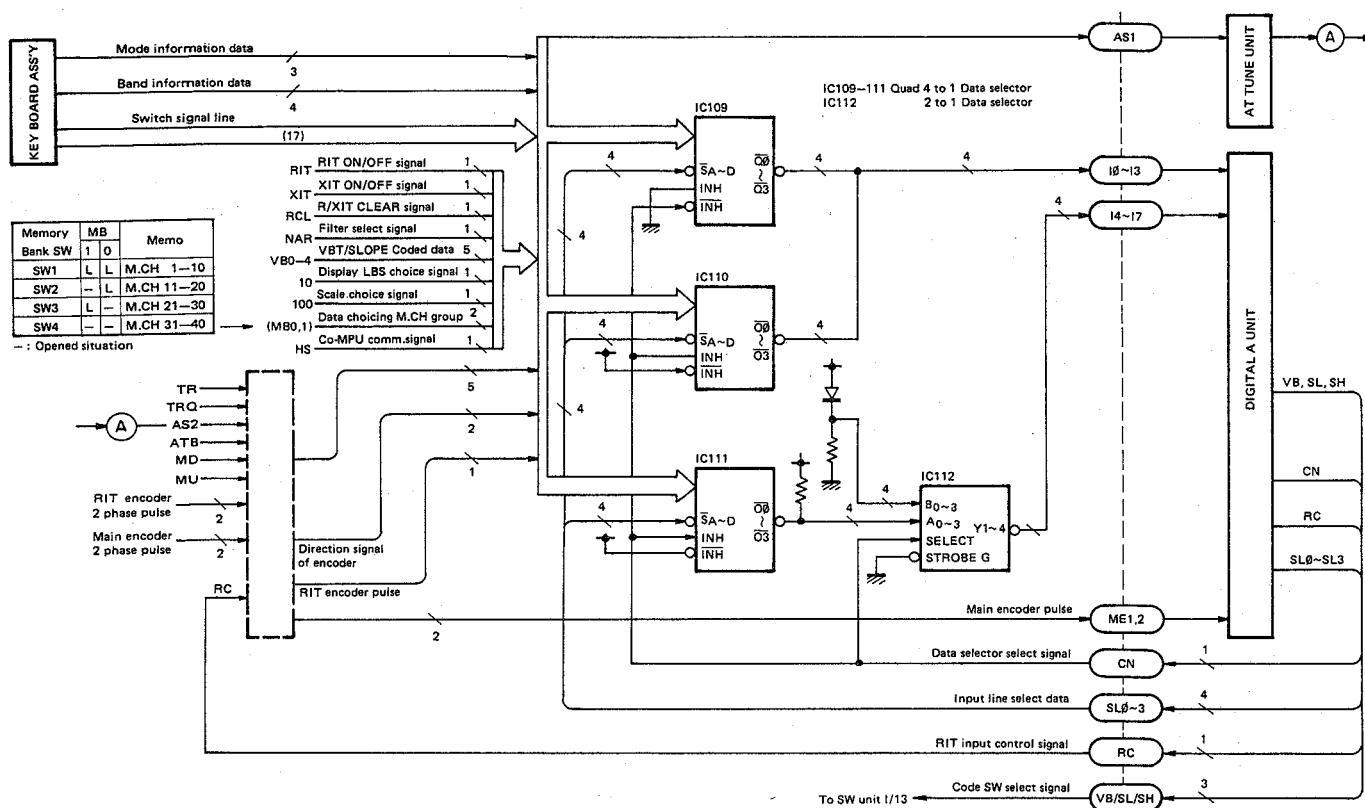


Fig. 29 Digital-B unit block diagram

## 2) Digital C unit

This unit is used to drive the fluorescent display tube along with the analog dial scale.

As the display data supplied from the Digital A unit has TTL level voltage, the display tube cannot be directly driven. To light the display tube, the drive voltages (heater voltage and display tube drive voltage) from the DC-DC unit is used together with the control data. The display data consists of time-division multiplexing of three data : the 7-segment data for digits, indicator data such as VFOA, MEMO, RIT, etc., and analog dial scale data. These data are also separated at this occasion.

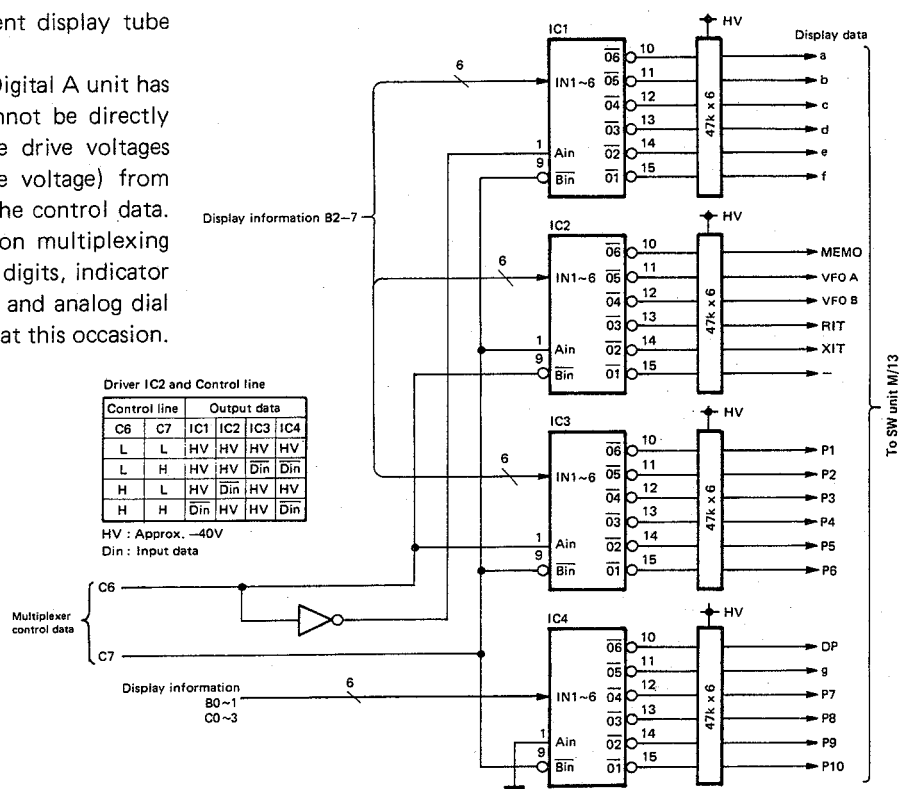


Fig. 30 Display data

## CIRCUIT DESCRIPTION

### 3) DC-DC unit

This unit generates the filament voltage for driving the fluorescent tube and the negative high voltage.

The 21V voltage from the Control unit is converted into -40V by the DC-DC converter.

### 4) Main Encoder ass'y and RIT Encoder unit

These optical encoders consisting of photoetched disks slit, and a photo-interrupter, both output 2-phase pulses with a phase difference of 90°. The direction of rotation is judged from this phase difference.

### 5) Switch unit

Description will be given for the circuitry around the liquid crystal display (hereafter abbreviated LCD.) The TS-940 uses a dual-display system using a newly-developed dot matrix LCD, in addition to a fluorescent tube : in addition to the operating frequency, the display can be switched for the frequency and mode of the alternate VFO, frequencies and modes of the memory channels, bandwidth of VBT/ SLOPE TUNE systems, and clock/timer display. The LCD ass'y consists of the dot matrix LCD and drive IC and is driven from the 4 bit/8 bit data bus. A new 4 bit microprocessor is used for this model and interfacing to the drive IC is performed in 4 bits. The 4 bit microprocessor performs operations such as switching of the display mode, setting of the clock and timer, switching of various displays, data communication with the main microprocessor, outputting of the audio data output from the optional voice synthesizer unit (VS-1), etc.

### 6) Digital A unit

This unit is the control center of units 1) to 5) and for data communications between them. It has a multitip 8-bit construction and the CPU uses a Z-80 operated at a clock rate of 2.5MHz.

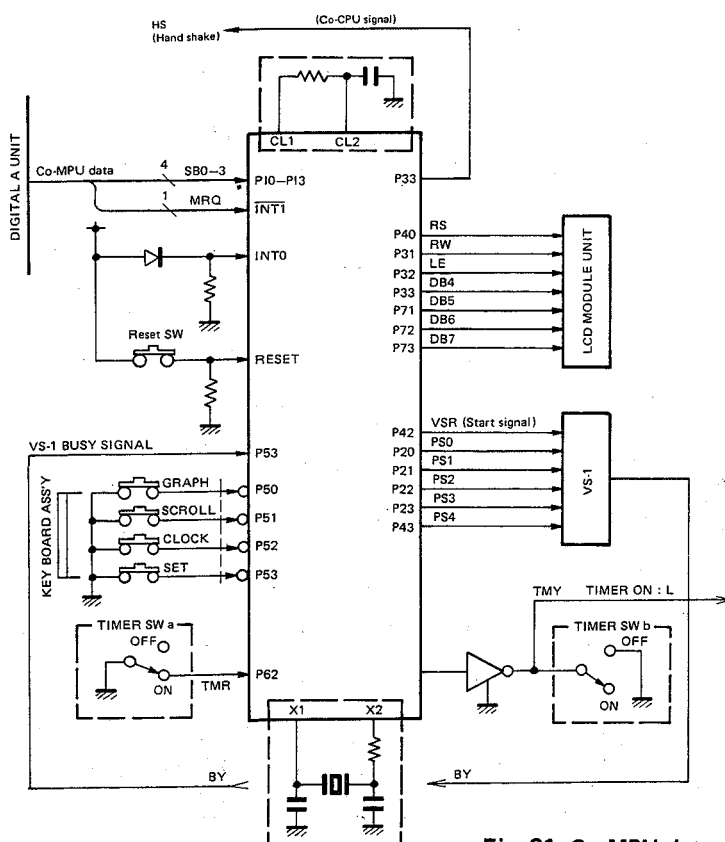
The main memory has a large 8-kByte capacity and the 2-kByte RAM backs up several data including the 40-ch memory data, VFO data, RIT frequency, and ON/OFF condition using a lithium battery. The backup timing is controlled by the system reset IC (IC20, PST5184), which interrupts execution at the instant the supply voltage falls below 4.2V to activate the backup mode. (Fig. 32)

The I/O system uses the memory-mapped I/O system : the 1st 8255 outputs the display data : the 2nd 8255 outputs the AT band data, LPF band data, data outputs for the three main loop PLL ICs and data outputs for the two carrier PLL ICs ; and the 3rd 8255 inputs the switch data and outputs the switch data output and the outputs for the LEDs.

The terminals for the RX bandpass data output and LCD-use submicroprocessor data output are also provided by using the latch output method.

For the antenna tuner standby operation, the AT In/Through condition (and also the presence of an AT in export models) is judged when the ATT SW is pressed : when the condition is OK, the AT standby pulse (active low, about 100μs) is output to the AT unit, which then stands by and sends back the AT Ready signal.

The microprocessor detects this Ready signal, automatically changes the mode to TUN. The mode changes back to the previous mode when tuning is complete. The AT coupler is always supplied with current band data for band switching. (Fig. 35) The standby signal is also supplied to the submicroprocessor so that the AT standby message is also output on the sub display. Other circuits used include the mode announce circuit (which indicates the switching of mode by CW codes) the PLL noise blanking circuit which suppresses noise during PLL reset pulse, and the "beep" sound control circuit which indicates when the various tactile switches are pressed.



## CIRCUIT DESCRIPTION

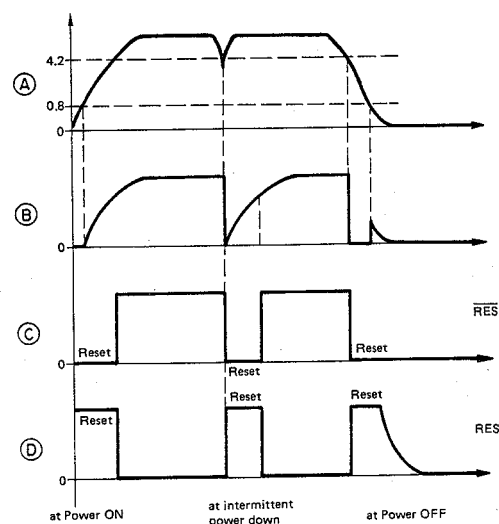
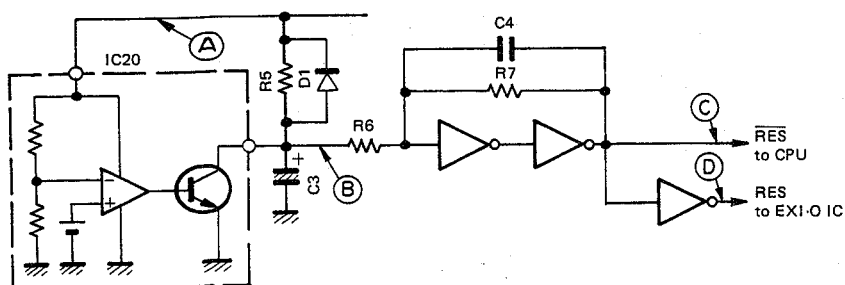


Fig. 32 Reset circuit

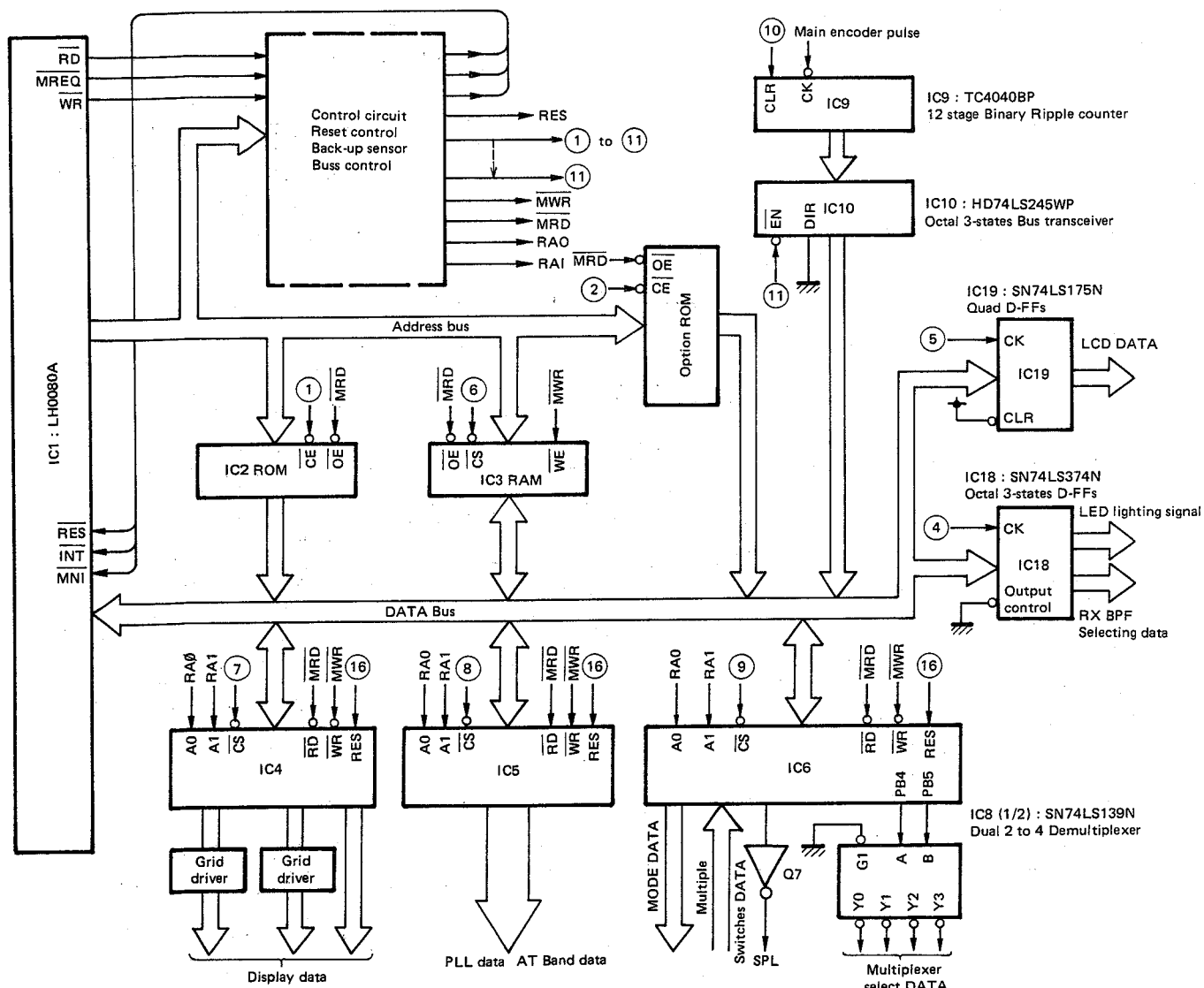


Fig. 33 Digital-A unit block diagram

## CIRCUIT DESCRIPTION

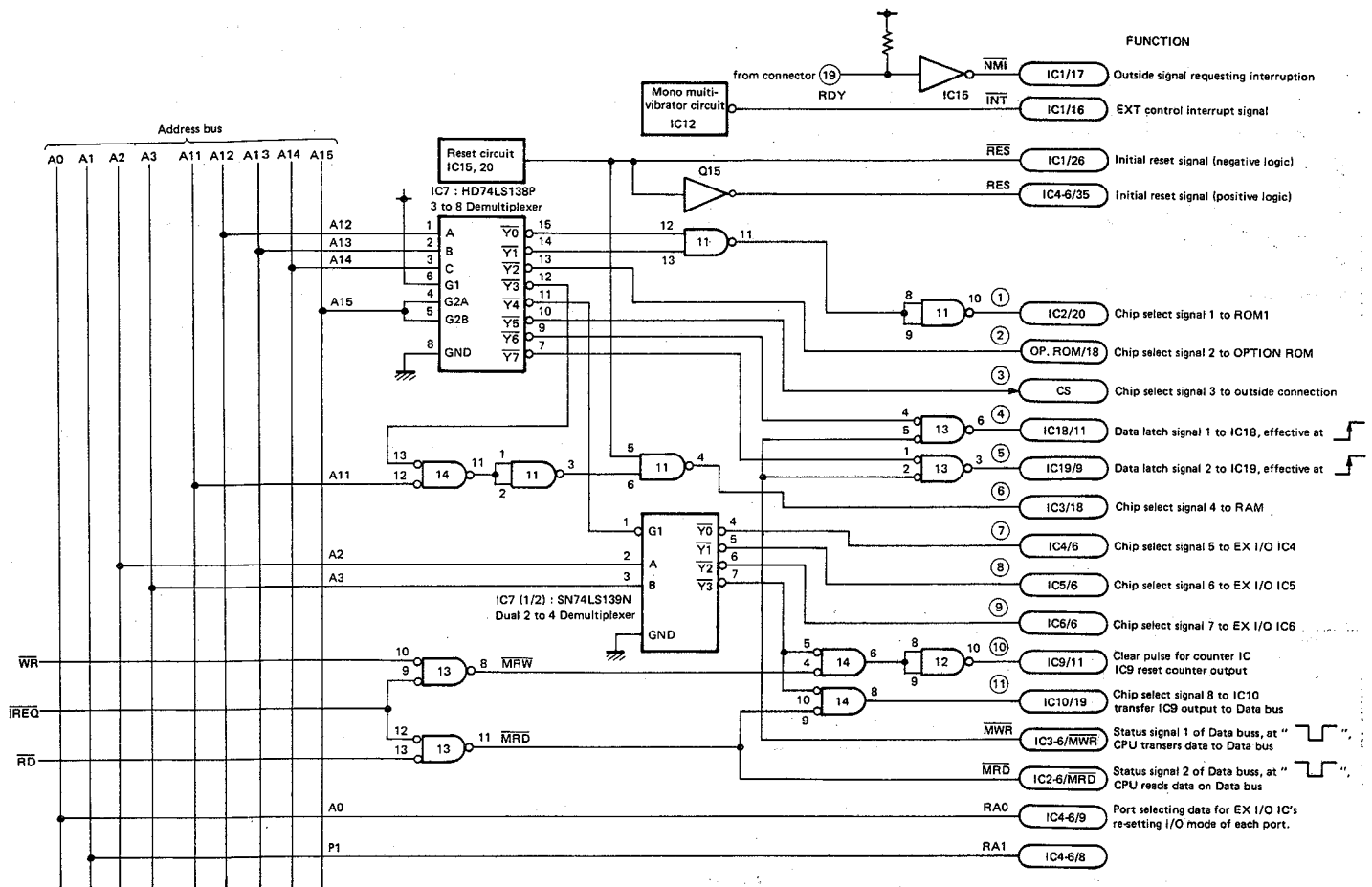


Fig. 34 Digital-A unit control logic diagram

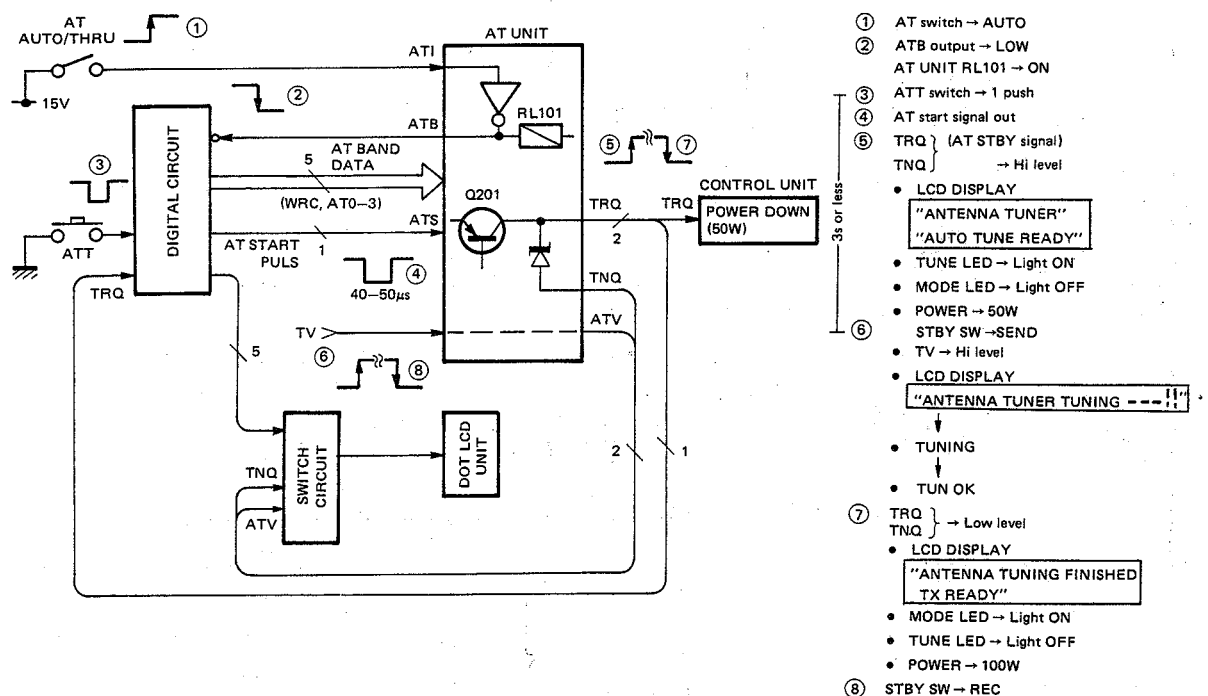


Fig. 35 Power control and AT unit

## CIRCUIT DESCRIPTION

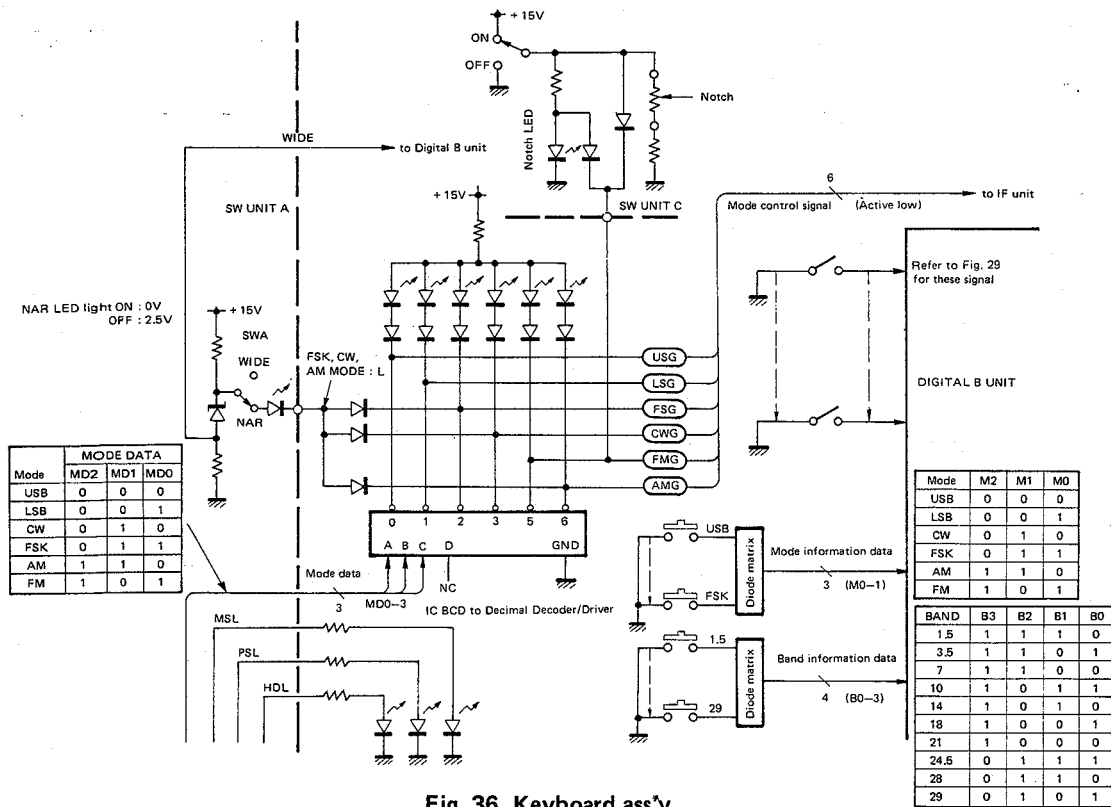


Fig. 36 Keyboard ass'y

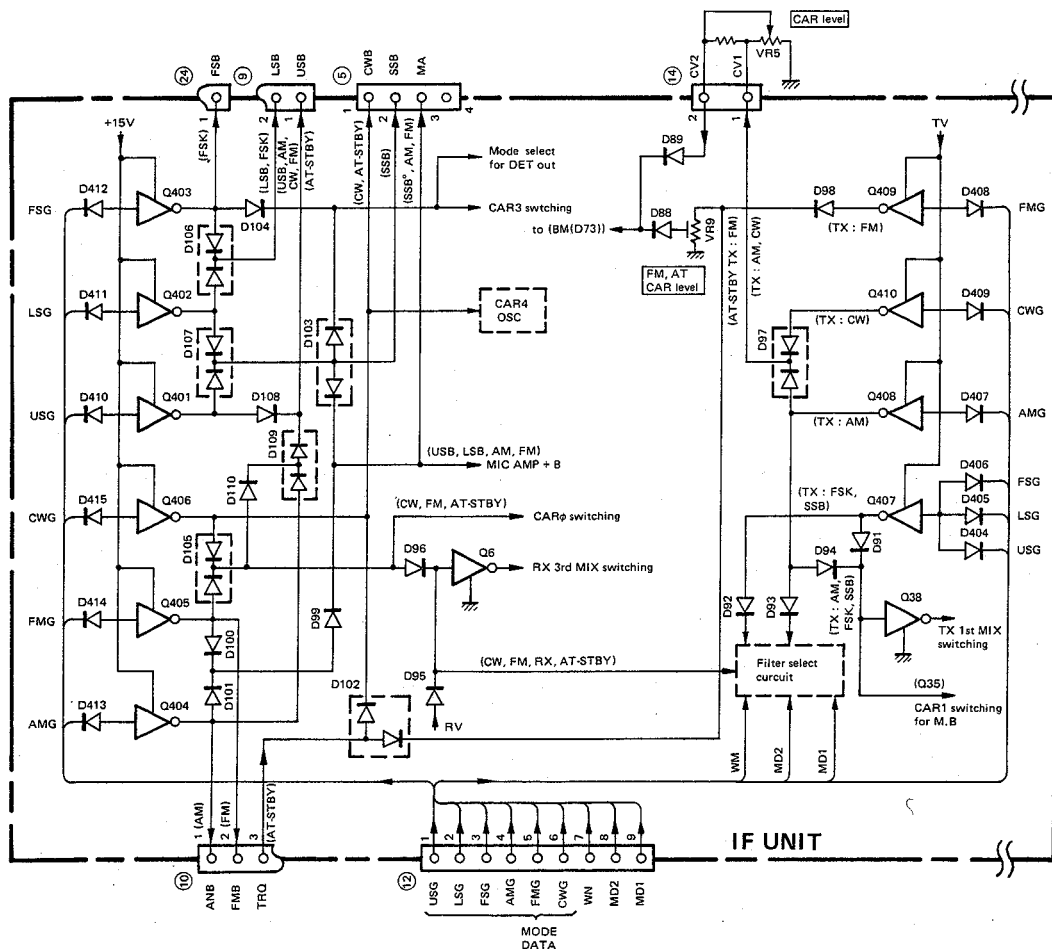


Fig. 37 Mode selector signal block diagram

## CIRCUIT DESCRIPTION

—: BPF cover range

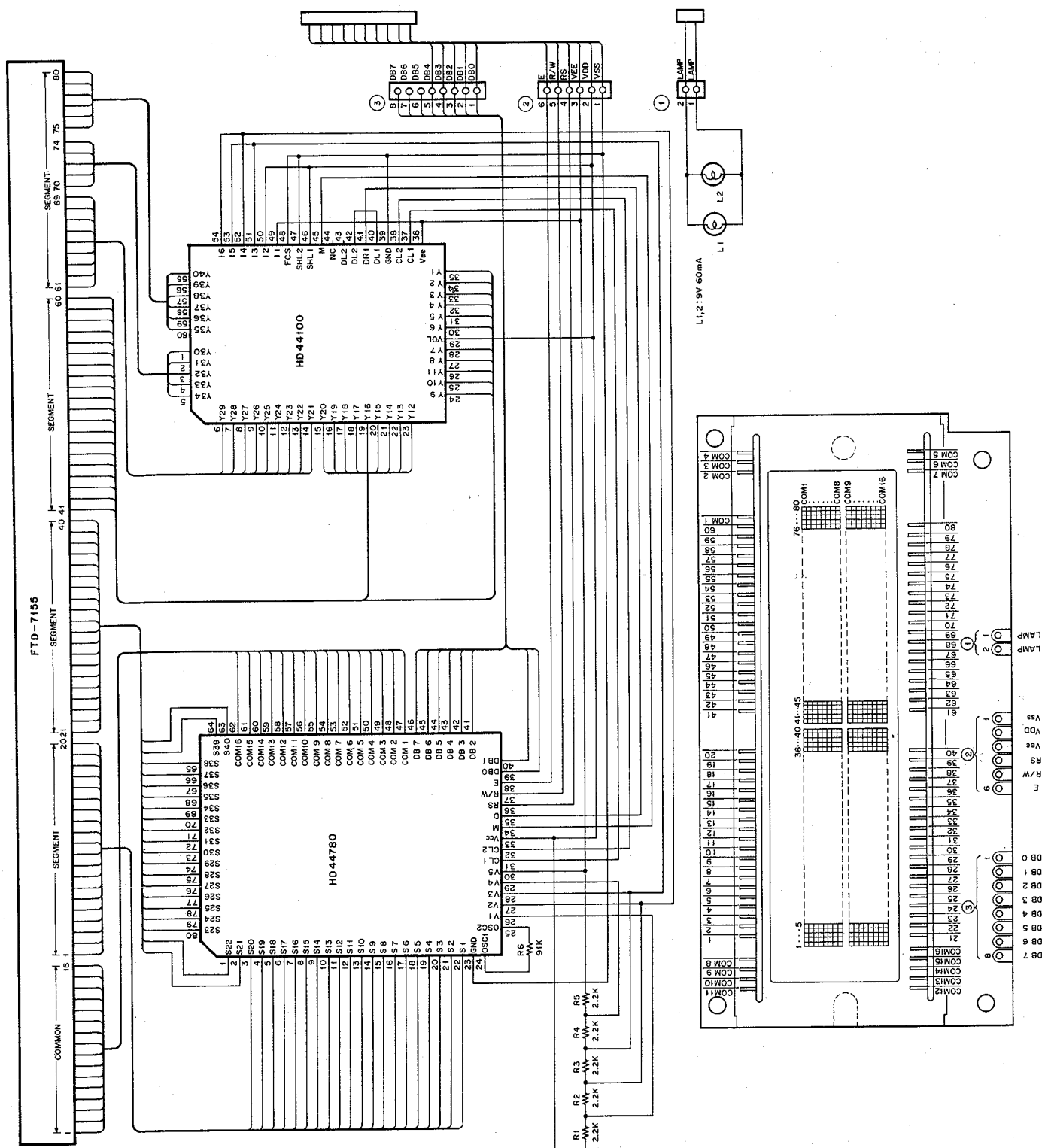
f (MHz)	N3	ND	NA	VCO	RX BPF				LPF			AT. BAND				
				VC	RB				LP			WRC	AT			
				1 0	3	2	1	0	2	1	0		3	2	1	0
0.0— 0.5	77	25	2	0 1	0	0	0	0	0	0	0	0	1	1	0	1
0.5— 1.0	76	25	1	0 1	0	0	0	1	0	0	0	0	1	1	0	1
1.0— 1.5	75	25	0	0 1	0	0	1	0	0	0	1	0	1	1	0	1
1.5— 2.0	74	24	2	0 1	0	0	1	0	0	0	1	0	1	1	0	1
2.0— 2.5	73	24	1	0 1	0	0	1	0	0	0	1	0	1	1	0	1
2.5— 3.0	72	24	0	0 1	0	0	1	0	0	1	1	0	1	1	0	0
3.0— 3.5	71	23	2	0 1	0	0	1	1	0	1	1	0	1	1	0	0
3.5— 4.0	70	23	1	0 1	0	0	1	1	0	1	1	0	1	1	0	0
4.0— 4.5	69	23	0	0 1	0	1	0	0	0	1	1	0	1	1	0	0
4.5— 5.0	68	22	2	0 1	0	1	0	0	1	1	1	0	1	1	0	0
5.0— 5.5	67	22	1	0 1	0	1	0	0	1	1	1	0	1	1	0	0
5.5— 6.0	66	22	0	0 1	0	1	0	0	1	1	1	0	1	0	1	0
6.0— 6.5	65	21	2	0 1	0	1	0	0	1	1	1	0	1	0	1	0
6.5— 7.0	64	21	1	0 1	0	1	0	0	1	1	1	0	1	0	1	0
7.0— 7.5	63	21	0	0 1	0	1	0	1	1	1	1	0	1	0	1	0
7.5— 8.0	62	20	2	0 1	0	1	0	1	1	1	1	0	1	0	1	0
8.0— 8.5	61	20	1	0 1	0	1	0	1	1	1	1	0	1	0	1	0
8.5— 9.0	60	20	0	0 1	0	1	1	0	1	1	0	0	1	0	1	0
9.0— 9.5	59	19	2	0 1	0	1	1	0	1	1	0	1	1	0	0	1
9.5—10.0	58	19	1	1 0	0	1	1	0	1	1	0	1	1	0	0	1
10.0—10.5	57	19	0	1 0	0	1	1	0	1	0	1	1	1	0	0	1
10.5—11.0	56	18	2	1 0	0	1	1	0	1	1	0	1	1	0	0	1
11.0—11.5	55	18	1	1 0	0	1	1	0	1	1	0	1	1	0	0	1
11.5—12.0	54	18	0	1 0	0	1	1	0	1	1	0	1	1	0	0	1
12.0—12.5	53	17	2	1 0	0	1	1	0	1	1	0	1	1	0	0	1
12.5—13.0	52	17	1	1 0	0	1	1	0	1	1	0	0	1	0	0	0
13.0—13.5	51	17	0	1 0	0	1	1	0	1	1	0	0	1	0	0	0
13.5—14.0	50	16	2	1 0	0	1	1	0	1	1	0	0	1	0	0	0
14.0—14.5	49	16	1	1 0	1	0	0	0	1	1	0	0	1	0	0	0
14.5—15.0	48	16	0	1 0	1	0	0	0	1	1	0	0	1	0	0	0
15.0—15.5	47	15	2	1 0	1	0	0	0	1	1	0	0	1	0	0	0
15.5—16.0	46	15	1	1 0	1	0	0	0	1	0	0	0	1	0	0	0
16.0—16.5	45	15	0	1 0	1	0	0	0	1	0	0	1	0	1	1	1
16.5—17.0	44	14	2	1 0	1	0	0	0	1	0	0	1	0	1	1	1
17.0—17.5	43	14	1	1 0	1	0	0	0	1	0	0	1	0	1	1	1
17.5—18.0	42	14	0	1 0	1	0	0	0	1	0	0	1	0	1	1	1
18.0—18.5	41	13	2	1 0	1	0	0	0	1	0	0	1	0	1	1	1
18.5—19.0	40	13	1	1 0	1	0	0	0	1	0	0	1	0	1	1	1
19.0—19.5	39	13	0	1 0	1	0	0	0	1	0	0	1	0	1	1	1
19.5—20.0	38	12	2	0 0	1	0	0	0	1	0	0	1	0	1	1	1
20.0—20.5	37	12	1	0 0	1	0	0	0	1	0	0	0	0	1	1	1
20.5—21.0	36	12	0	0 0	1	0	0	0	1	0	0	0	0	1	1	1
21.0—21.5	35	11	2	0 0	0	1	1	1	1	0	0	0	0	1	1	1
21.5—22.0	34	11	1	0 0	0	1	1	1	1	0	0	0	0	1	1	1
22.0—22.5	33	11	0	0 0	0	1	1	1	0	1	0	0	0	1	1	1
22.5—23.0	32	10	2	0 0	0	1	1	1	0	1	0	0	0	1	1	1
23.0—23.5	31	10	1	0 0	0	1	1	1	0	1	0	1	0	1	1	0
23.5—24.0	30	10	0	0 0	0	1	1	1	0	1	0	1	0	1	1	0
24.0—24.5	29	9	2	0 0	0	1	1	1	0	1	0	1	0	1	1	0
24.5—25.0	28	9	1	0 0	0	1	1	1	0	1	0	1	0	1	1	0
25.0—25.5	27	9	0	0 0	0	1	1	1	0	1	0	1	0	1	1	0
25.5—26.0	26	8	2	0 0	0	1	1	1	0	1	0	1	0	1	1	0
26.0—26.5	25	8	1	0 0	0	1	1	1	0	1	0	1	0	1	1	0
26.5—27.0	24	8	0	0 0	0	1	1	1	0	1	0	1	0	1	1	0
27.0—27.5	23	7	2	0 0	0	1	1	1	0	1	0	0	0	1	1	0
27.5—28.0	22	7	1	0 0	0	1	1	1	0	1	0	0	0	1	1	0
28.0—28.5	21	7	0	0 0	0	1	1	1	0	1	0	0	0	1	1	0
28.5—29.0	20	6	2	0 0	0	1	1	1	0	1	0	0	0	1	1	0
29.0—29.5	19	6	1	0 0	0	1	1	1	0	1	0	0	0	1	1	0
29.5—30.0	18	6	0	0 0	0	1	1	1	0	1	0	0	0	1	1	0
30.0—30.5	17	5	2	0 0	0	1	1	1	0	1	0	0	0	1	1	0

\*N3 = 3ND + NA

Table 20 Frequency control data

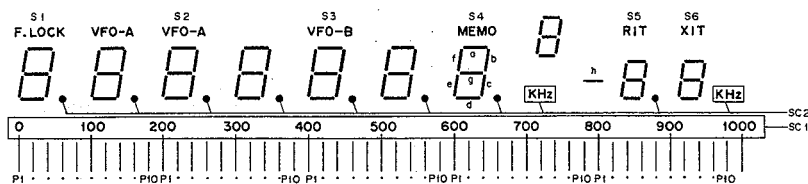
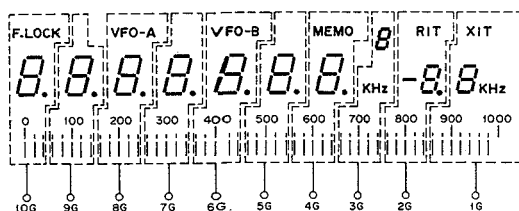


# SEMICONDUCTOR DATA

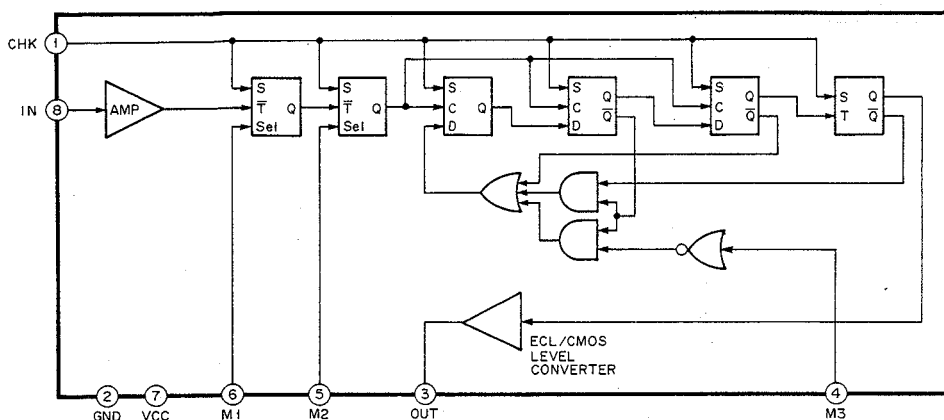


FTD-7155 (LCD unit V1)

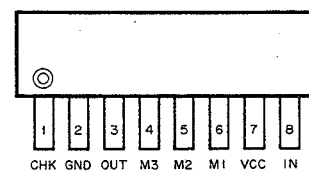
## SEMICONDUCTOR DATA



11-BT-05Z (SW unit-M V1)



HD10551 Block diagram (PLL unit IC5, 11)

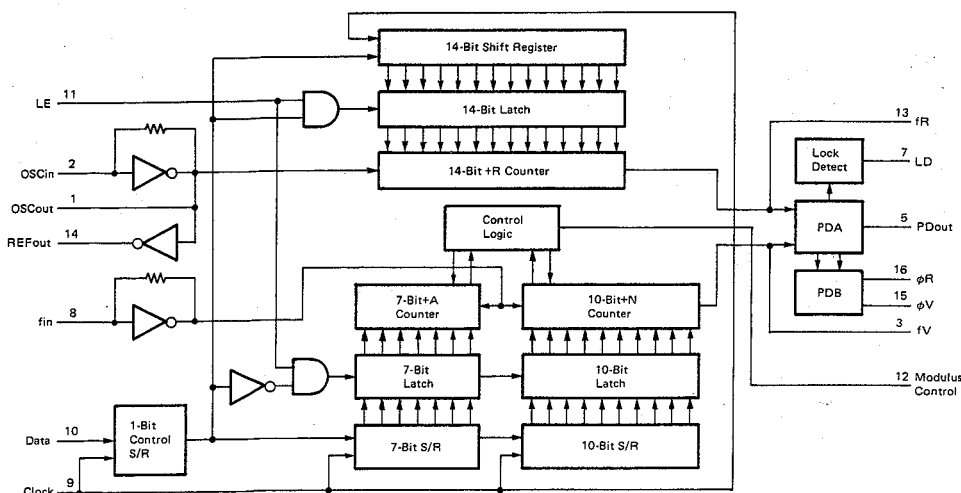


HD10551 Terminal

Symbol	Value	Unit
Vcc	8	V
Vin	8	V
PT	350 (at 75°C)	mW
Topr	-30~ + 75	°C
Tstg	-55~ + 125	°C

HD10551 Max. rating

Divid	CHK 1 pin	M1 6 pin	M2 5 pin	M3 4 pin
1/10	GND	Vcc	Vcc	GND
1/11	GND	Vcc	Vcc	Vcc
1/20	GND	GND	Vcc	GND
1/22	GND	GND	Vcc	Vcc
1/40	GND	GND	GND	GND
1/44	GND	GND	GND	Vcc

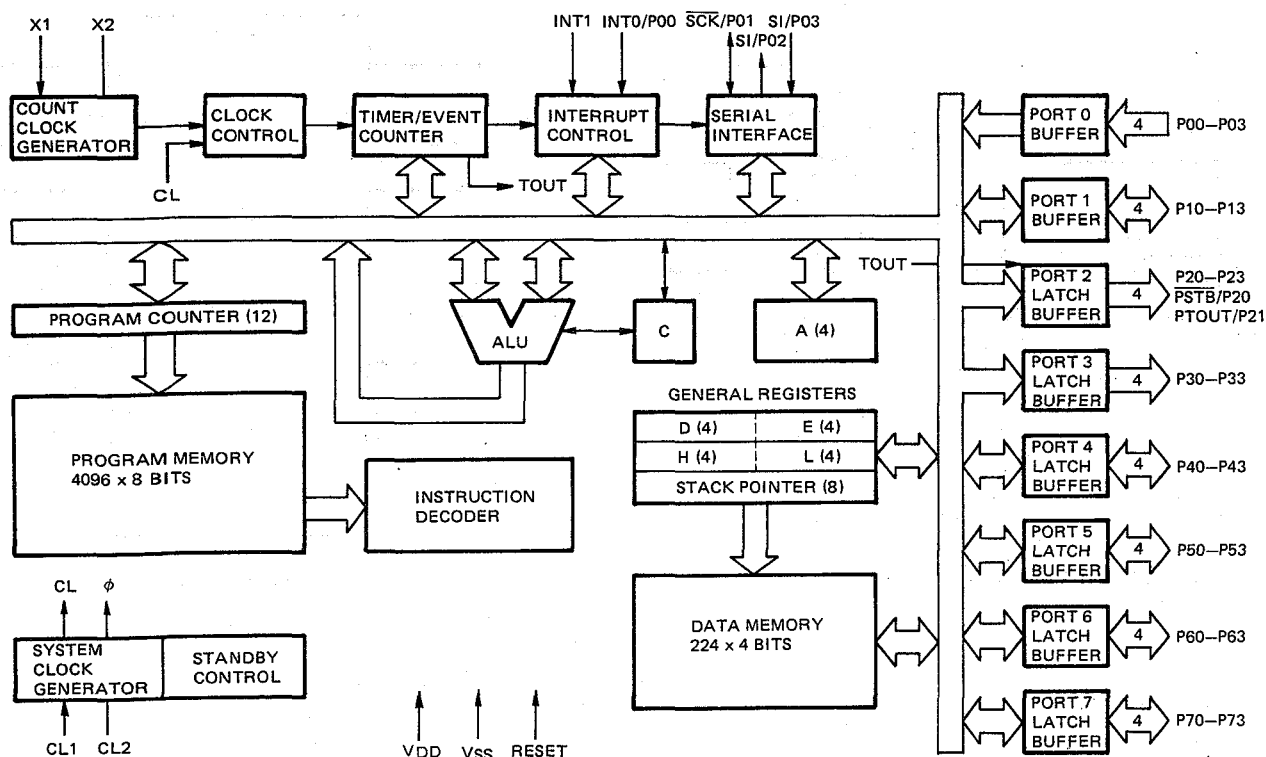


MC145158P Block diagram (PLL unit IC17)

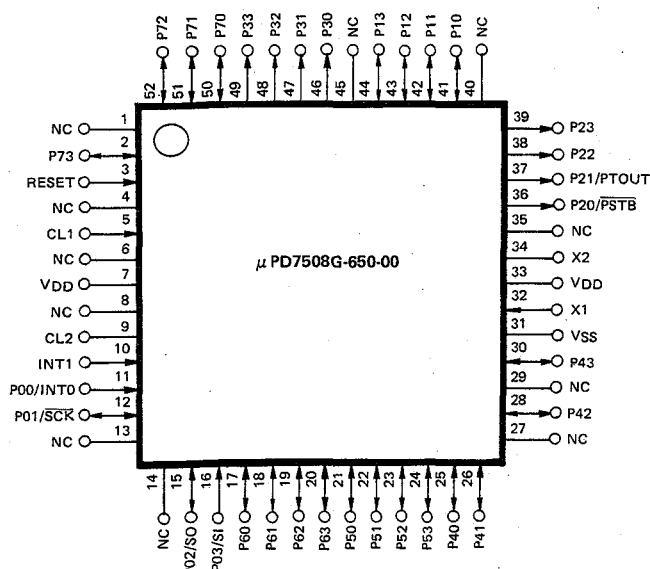
Symbol	Value	Unit
VDD	-0.5 to + 10	V
Vin	-0.5 to VDD + 0.5	V
I	10	mA
I	30	mA
TA	-40 to + 85	°C
Tstg	-65 to + 150	°C

MC145158P Max. rating

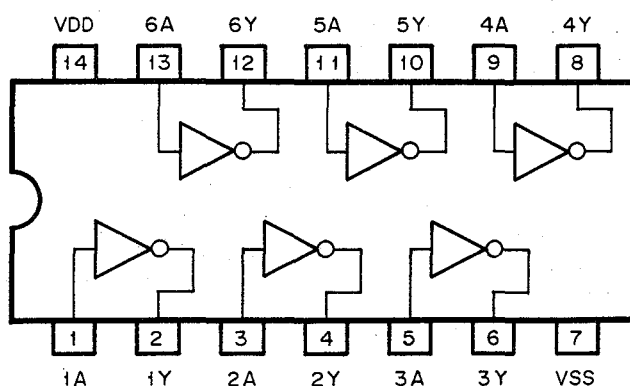
## SEMICONDUCTOR DATA



μPD7508G-650-00 Block diagram (SW unit (L) IC1)



μPD7508G-650-00 (Top view)

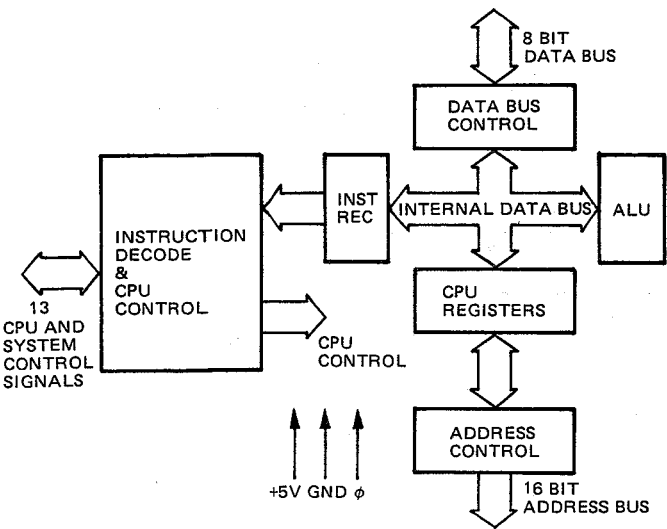


TC40H004P (DG-A unit IC15)

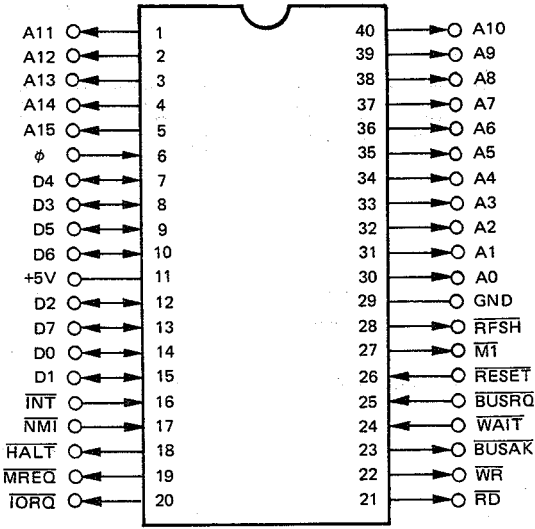
Symbol	Rating	Unit
VDD	V <sub>SS</sub> -0.5~V <sub>SS</sub> + 10	V
VIN	V <sub>SS</sub> -0.5~VDD + 0.5	V
VOUT	V <sub>SS</sub> -0.5~VDD + 0.5	V
IIN	±10	mA
PD	300 (DIP)/180 (MFP)	mW
Totg	-65~150	°C
Tsol	260°C · 10sec	

TC40H004P Max. rating

SEMICONDUCTOR DATA



LH-0080A Block diagram (DG-A unit IC1)



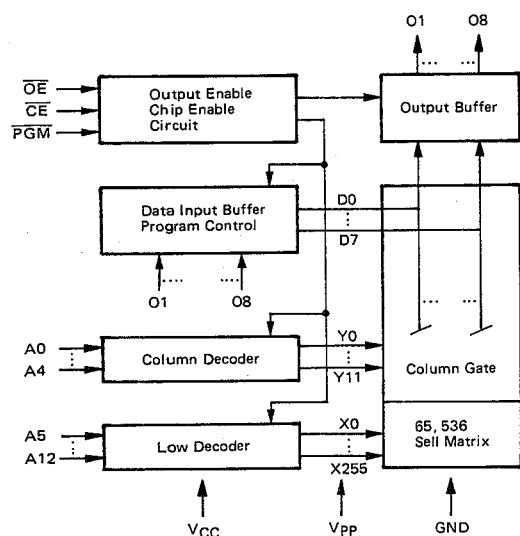
LH-0080A (Top view)

MAIN REG SET		ALTERNATE REG SET		GENERAL PURPOSE REGISTERS	SPECIAL PURPOSE REGISTERS	
ACCUMULATOR	FLAGS	ACCUMULATOR	FLAGS		INTERRUPT VECTOR I	MEMORY REFRESH R
A	F	A	F'		INDEX REGISTER IX	
B	C	B	C'		INDEX REGISTER IV	
D	E	D'	E		STACK POINTER SP	
H	L	H'	L'		PROGRAM COUNTER PC	

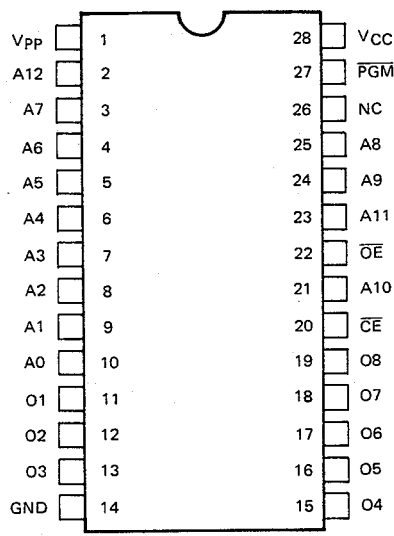
Terminal		Terminal Function	Terminal		Terminal Function
No.	Name		No.	Name	
1	A11	Address bus	21	RD	Read strobe output
2	A12		22	WR	Write strobe output
3	A13		23	BUSAK	Not used
4	A14		24	WAIT	Not used.
5	A15		25	BUSRQ	Not used.
6	φ	Clock input approx. 2.5MHz	26	RESET	Reset input (active : L)
7	D4	Data bus	27	MT	Not used.
8	D3		28	RFSH	Not used.
9	D5		29	GND	GND
10	D6		30	A0	Address bus
11	+ 5V	Power supply	31	A1	
12	D2	Data bus	32	A2	
13	D7		33	A3	
14	D0		34	A4	
15	D1		35	A5	
16	INT	Interrupt input	36	A6	
17	MNI	External control interrupt input	37	A7	
18	HALT	Not used.	38	A8	
19	MREQ	External access. signal output	39	A9	
20	TORQ	Not used.	40	A10	

LH-0080A Terminal function

SEMICONDUCTOR DATA



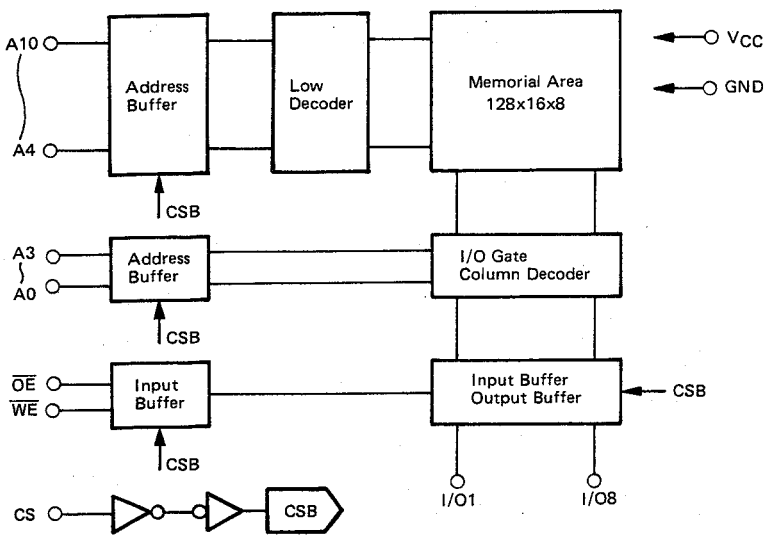
MBM2764-30 Block diagram (DG-A unit IC2)



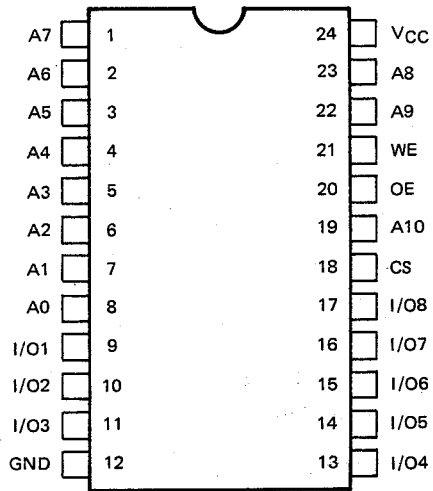
MBM2764-30 (Top view)

Symbol	Terminal Name	Symbol	Terminal Name
A0—A12	Address input	Vpp	Program power supply
O1—O8	Data output (input)	Vcc	Power supply (+ 5V)
CE	Chip enable	GND	Ground
OE	Output enable	NC	No connection
PGM	Program input-output enable		

MBM2764-30 Terminal name



MB8416-20LP-GRA Block diagram (DG-A unit IC3)

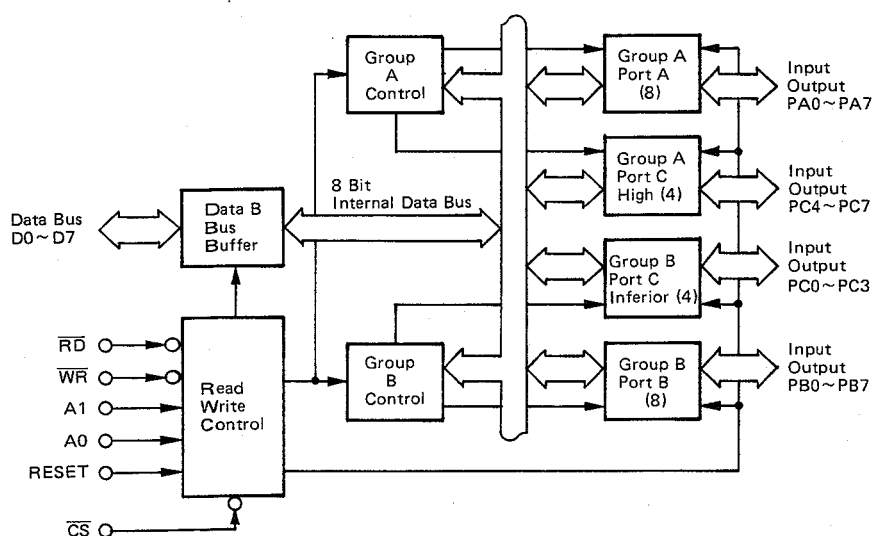


MB8416-20LP-GRA (Top view)

Symbol	Terminal Functions	Symbol	Terminal Functions
A0—A10	Address input	WE	Write enable
I/O1—I/O8	Data input, output	Vcc	Power supply (+5V)
CS	Chip select	GND	Ground
OE	Output enable	NC	Not connected.

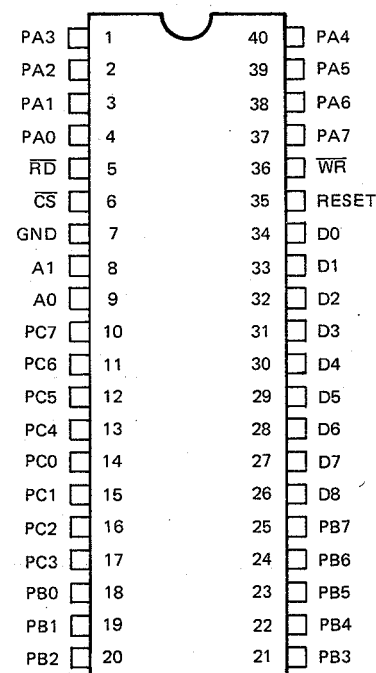
MB8416-20LP-GRA Terminal name

# SEMICONDUCTOR DATA



Terminal name  
D0—D7 : Data bus (each direction)    A0,A1 : Port address  
CS : Chip select    PA0—PA7 : Port A input, output  
RESET : Reset    PB0—PB7 : Port B input, output  
RD : Read control    PC0—PC7 : Port C input, output  
WR : Write control

μPD8255AC-5 Block diagram (DG-A unit IC4—6)



μPD8255AC-5 (Top view)

Terminal		Terminal Function	Terminal		Terminal Function
No.	Name		No.	Name	
1	PA3	Display tube grid drive signal G4	21	PB3	Segment data b/VFO A/P2
2	PA2	Display tube grid drive signal G3	22	PB4	Segment data c/VFO B/P3
3	PA1	Display tube grid drive signal G2	23	PB5	Segment data d/RIT/P4
4	PA0	Display tube grid drive signal G1	24	PB6	Segment data e/XIT/P5
5	RD	Read strobe input	25	PB7	Segment data f/—/P6
6	CS	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	Data bus
8	A1	Address signal input	28	D6	
9	A0	Address signal input	29	D5	
10	PC7	Segment data control bit	30	D4	
11	PC6		31	D3	
12	PC5	Display tube grid drive signal G10	32	D2	
13	PC4	Display tube grid drive signal G9	33	D1	
14	PC0	Analog data P7	34	D0	
15	PC1	Analog data P8	35	Reset	Reset input (Active : H)
16	PC1	Analog data P9	36	WR	Write strobe input
17	PC3	Analog data P10	37	PA7	Display tube grid drive signal G8
18	PB0	Segment data dp	38	PA6	Display tube grid drive signal G7
19	PB1	Segment data g	39	PA5	Display tube grid drive signal G6
20	PB2	Segment data a/MEMO/P1	40	PA4	Display tube grid drive signal G5

Note) Each data of pins 20—26 is chosen by the three types data of pins 10,11.

## Terminal function (IC4)

# SEMICONDUCTOR DATA

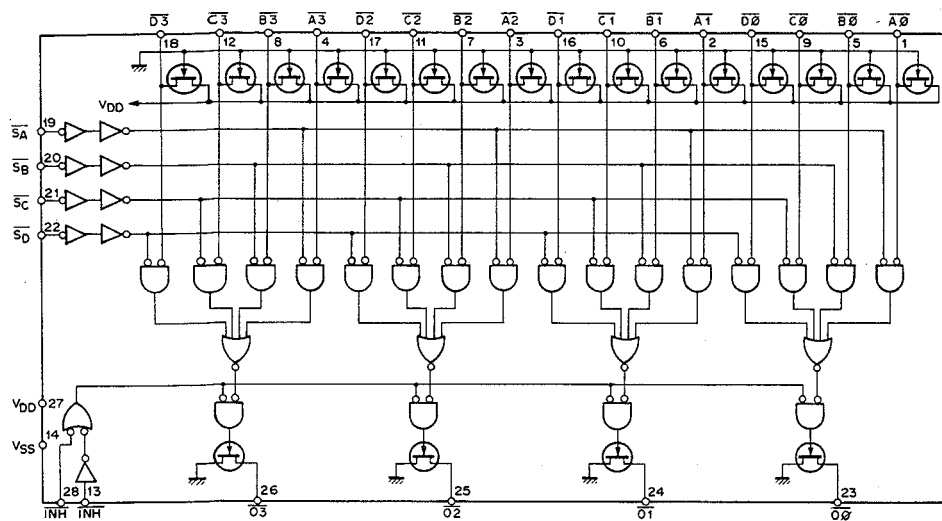
Terminal			Terminal		
No.	Name	Terminal Function	No.	Name	Terminal Function
1	PA3	AT3	21	PB3	DA3 PLL data for MN6147 bit 3
2	PA2	AT2	22	PB4	CL0 HET 36M PLL clock
3	PA1	AT1	23	PB5	CL1 Main loop 10Hz PLL clock
4	PA0	AT0	24	PB6	CL2 Main loop 10kHz
5	RD	Read strobe input	25	PB7	CL3 Main loop 500k
6	CS	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	Data bus
8	A1	Address signal input	28	D6	
9	A0	Address signal input	29	D5	
10	PC7	PLD Main loop 500k PLL data	30	D4	
11	PC6	PLE Main loop 500k PLL latch enable	31	D3	
12	PC5	CL5 CAR PLL clock for 71.5MHz	32	D2	
13	PC4	CL4 CAR PLL clock for 45.5MHz	33	D1	
14	PC0	VBT Cord SW select output	34	D0	
15	PC1	SPL Cord SW select output	35	Reset	Reset input (Active : H)
16	PC2	SPH Cord SW select output	36	WR	Write strobe input
17	PC3	BLK Blanking pulse	37	PA7	LP2
18	PB0	DA0	38	PA6	LP1
19	PB1	DA1	39	PA5	LP0
20	PB2	DA2	40	PA4	WRC AT Band data

Terminal function (IC5)

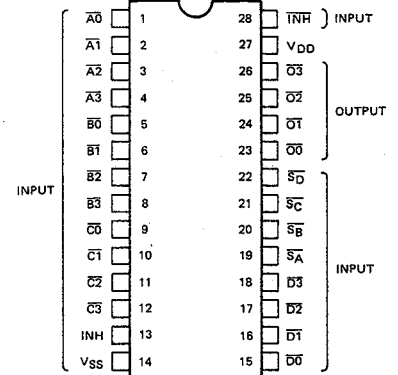
Terminal			Terminal		
No.	Name	Terminal Function	No.	Name	Terminal Function
1	PA3	N/W, Narrow, wide output	21	PB3	Lock indicator output
2	PA2	ML2	22	PB4	SW select output A
3	PA1	ML1 Mode LED output	23	PB5	SW select output B
4	PA0	MLO	24	PB6	SW control output
5	RD	Read strobe input	25	PB7	RIT Clear pulse
6	CS	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	Data bus
8	A1	Address signal input	28	D6	
9	A0	Address signal input	29	D5	
10	PC7	SW data input port	30	D4	
11	PC6		31	D3	
12	PC5		32	D2	
13	PC4		33	D1	
14	PC0		34	D0	
15	PC1		35	Reset	Reset input (Active : H)
16	PC2		36	WR	Write strobe input
17	PC3		37	PA7	Buzzer pulse
18	PB0	TX standby output	38	PA6	Band data
19	PB1	Split LED output	39	PA5	VC1
20	PB2	AT start pulse output	40	PA4	VC0

Terminal function (IC6)

## SEMICONDUCTOR DATA



LC7800 Equivalent circuit (DG-B unit IC109-111)



LC7800 (Top view)

Input																Output			
Data input																			
A				B				C				D							
A0	A1	A2	A3	B0	B1	B2	B3	C0	C1	C2	C3	D0	D1	D2	D3	SA	SB	SC	SD
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	0	1	1
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	*	1	1
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	1	1

(Note) 1 : H level/0 : L level/\* : don't care

LC7800 Truth table



# PARTS LIST TS-940S

## CAPACITORS

CC 45 TH 1H 220 J  
1 2 3 4 5 6

- 1 = Type ..... ceramic, electrolytic, etc.  
2 = Shape ..... round, square, etc.  
3 = Temp. coefficient  
4 = Voltage rating  
5 = Value  
6 = Tolerance

### • Temperature Coefficient

1st Word	C	L	P	R	S	T	U
Color*	Black	Red	Orange	Yellow	Green	Blue	Violet
ppm/°C	0	-80	-150	-220	-330	-470	-750

### • Tolerance

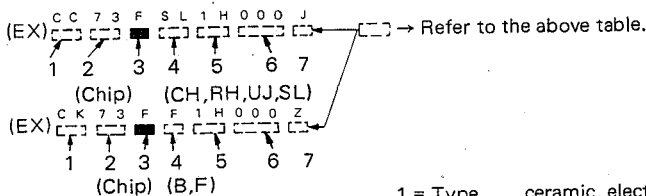
Code	C	D	G	J	K	M	X	Z	P	No code
(%)	± 0.25	± 0.5	± 2	± 5	± 10	± 20	+ 40 - 20	+ 80 - 20	+ 100 - 0	10μF-10~+50 4.7μF-10~+75

Less than 10 pF

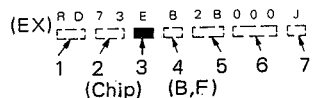
### • Rating voltage

2nd word	A	B	C	D	E	F	G	H	J	K	V
1st word											
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	—
1	10	12.5	16	20	25	31.5	40	50	63	80	35
2	100	125	160	200	250	315	400	500	630	800	—
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	—

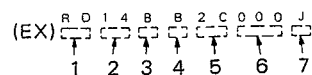
### • Chip capacitors



### • Chip resistor (Carbon)



### • Carbon resistor (Normal type)



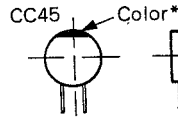
- 1 = Type ..... ceramic, electrolytic, etc.  
2 = Shape ..... round, square, etc.  
3 = Dimension  
4 = Temp. coefficient  
5 = Voltage rating  
6 = Value  
7 = Tolerance.

### • Capacitor value

- 0 1 0 = 1pF  
1 0 0 = 10pF  
1 0 1 = 100pF  
1 0 2 = 1000pF = 0.001μF

1 0 3 = 0.01μF

2 2 0 = 22pF  
1st number | Multiplier  
2nd number



Example CC45TH = -470±60 ppm/°C

### Dimension

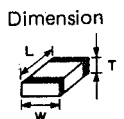
Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

### Dimension

Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

### Rating wattage

Cord	Wattage	Cord	Wattage	Cord	Wattage
2A	1 10W	2E	1 4W	3A	1W
2B	1 8W	2H	1 2W	3D	2W
2C	1 6W				

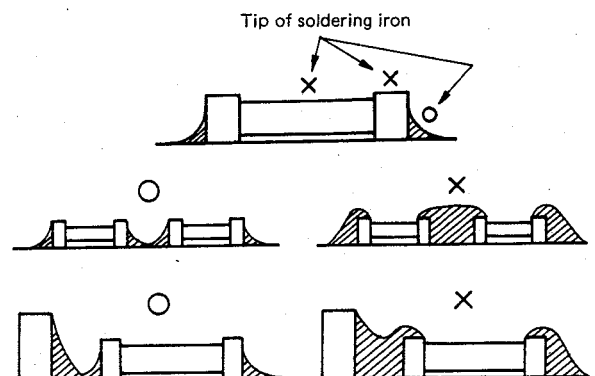


### Note :

#### Soldering procedure for the tip condenser

- Tools and materials
  - Soldering iron
  - Slit tip
  - Solder (Silver solder or low temperature solder)
  - Pincers made of bamboo
  - Hot plate or drier
- Soldering procedure
  - Pre-heat the surface of tip condenser up to around 150°C with the hot plate or drier.
  - Put the solder on the tip of soldering iron.
  - Hold and place the tip condenser on the installation place with the pincers made of bamboo.
  - Solder one end of the tip condenser using the tip of soldering iron.
  - Solder the other end similarly.
- Caution
  - Flatten the solder on the pattern where the tip condenser is to be installed. Do not swell it.
  - Length of soldering time :
    - In case of silver solder : Within 6 – 8 sec.
    - In case of low temperature solder : Within 3 – 4 sec.

- 3) Keep the temperature of tip of soldering iron below 280°C.



**Note:** If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.  
Use care when soldering. Liberal use of additional flux will ease the task of soldering.

# 'S-940S PARTS LIST

## SEMICONDUCTOR

N : New parts

\* : Please note that parts are sometimes not in stock and it takes much time to deliver.

Item	Re- marks	Part No.	Item	Re- marks	Part No.	Item	Re- marks	Part No.	Item	Re- marks	Part No.
<b>Diode</b>		1N60	<b>LED</b>		LN66(S)	<b>FET</b>		2SK30A(GR)			SN74LS32N
		1N4448			LN01201C			2SK30A(O)			SN74LS73AN
		1S1007			LN01301C			2SK125			SN74LS90N
		1S1555			LN01401C			2SK125P			SN74LS138N
		1S1587			LT8001P			2SK192A(GR)			SN74LS139N
		1S2588			SG238D			2SK192A(GR)*J			SN74LS145N
		1SS99									SN74LS175N
		1SS133			DSA441 LA			3SK73(Y)			SN74LS245N
		GM-3B									SN74LS374N
		MC911			25D29			BA718			SN74S10N
		MC921			112-103-2			BU4001B			SN74S112N
		MC931			112-501-2						SN16913P
		MI204			112-503-2			HA1368			TA78L008AP
		S15VB10			5TP-41L			HD74LS138P			TA7140P
		U05B						HD74LS245P			TA7302P
<b>D.B.M.</b>		ND487R1-3R	<b>Display tube</b>	N	11-BT-05Z	<b>IC</b>		HD74LS245WP			TC40H004P
							N	HD4410	N		TC4001BP
<b>Varistor</b>		MV-203	<b>LCD</b>	N	FTD-7155		N	HD4478			TC4011BP
		STV-3H(O,Y)					N	HD10116			TC4027BP
<b>Varactor</b>		SV03YS	<b>Photo TR</b>		0N1110			HD10125			TC4040BP
					PN126S		N	HD10131			TC4049BP
<b>Voltage variable</b>		1SV123	<b>Digital TR</b>		DTA114ES			HD10551			TC4073BP
		1SV54GC			DTA124ES			LC7800			TC5065BP
<b>Zener diode</b>		1SV149A		N	DTA143EF			LM358P			TMP8255AP-5
		BZ-192		N	DTA143ES			M5L8255AP-5			μA7818UC
		BZ-320		N	DTA143XS			M74LS32P			μPC78L05A
		BZ-350		N	DTC114ES			M54459L			μPC78L08A
		MTZ3.0JB			DTC124EF			M54561P			μPC577H
		MTZ3.6JB		N	DTC124ES			MB3614			μPC1037H
		MTZ3.9J			DTC144WS			MB8416-20LP-GRA			μPC7805H
		MTZ3.9JB	<b>TR</b>		2N5885			MBM2764-30T2			μPC7812H
		MTZ4.3J			2SA950(Y)			MC74HC157N			μPC7815H
		MTZ5.1J(A,B)			2SA966(O)			MC1723C			μPD8255AC-5
		MTZ5.1JA			2SA984K(E)			MC10116L			
		MTZ5.6J			2SA1015(Y)			MC10125L			LH0080A
		MTZ5.6JA			2SA1048(Y)			MC10131L			μPD780C-1
		MTZ5.6JB			2SA1049(GR)			MC14077BCP			μPD7508G-650-00
		MTZ6.2JB			2SA1115(E)			MC14569BCP			
		MTZ6.8J			2SB861(C)		N	MC145158P			
		MTZ9.1J			2SC496(Y)			MN6147			
		MTZ9.1JA			2SC1907			MN6147C			
		MTZ9.1JC			2SC1959(Y)			NE555P			
		MTZ10J			2SC1973(T)		N	NE556N			
		MTZ10J(A,B)			2SC2053			NJM2901			
		MTZ10JC			2SC2075			NJM2903D			
		MTZ11JC			2SC2120(Y)			NJM2904D			
		MTZ12J			2SC2235(O)			NJM4558S			
		MTZ12JC			2SC2274K(E)						
		MTZ16J(A,B)			2SC2458(Y)			PST518A			
		MTZ16JA			2SC2459(BL)						
		MTZ16JC			2SC2668(Y)						
		MTZ18JA			2SC2787(L)						
		MTZ18JC			2SC3113(B)						
		MTZ20J			2SD880(Y)						
		MTZ20JC			2SD1266(P,Q)						
		MTZ24JD			2SD1406(Y)						
					MRF422						
					MRF485						

# PARTS LIST TS-940S

## TS-940S GENERAL

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
A01-0988-01	N*	METALLIC CASE UPPER	1	
A01-0989-11	N*	METALLIC CASE LOWER	1	
A20-2542-02	N*	PANEL	1	
A23-1486-02	N*	REAR PANEL	1	
BU4001B		C.MOS IC 2-INPUT NOR X4	1	IC 102
B03-0525-04	*	SWITCH MASK	1	
B03-0539-04	N*	SWITCH MASK POWER/TIMER	1	
B03-0540-04	N*	SWITCH MASK SEND/REC	1	
B03-0541-04	N*	SWITCH MASK RIT/XIT	1	
B05-0722-04	*	SP. GRILE	1	
B10-0673-03	N	FRONT GLASS	1	
B10-0674-04	N	FRONT GLASS LCD	1	
B11-0426-04	N	LIGHT GUIDING PLATE METER	1	
B30-0817-15		LAMP 14V 80MA	2	PL 1, 2
B31-0656-05	N	METER	1	
B40-3571-04	N*	MODEL NAME PLATE TS-940S KMTW	1	
B40-3572-04	N*	MODEL NAME PLATE TS-94X X	1	
B42-1729-04	*	PLATE"WITH ANTENNA TUNER"	1	
B42-1739-14	*	VOLTAGE IND' PLATE:120V K	1	
B42-1740-04	*	VOLTAGE IND' PLATE:220V MW	1	
B42-1741-04	*	VOLTAGE IND' PLATE:240V TX	1	
B42-2388-14	N*	ADJ. SEAL VOX CONTROL	1	
B42-2389-04	N*	ADJ. SEAL SIDE-TONE/BUZ/MONI	1	
B42-2390-04	N*	ADJ. SEAL CAR BALANCE	1	
B42-2391-23	N*	TS-940S HF TRANSCEIVER KMTW	1	
B42-2392-23	N*	TS-940X HF TRANS	1	
B42-2399-04	*	FACE PLATE	1	
B43-1045-04	N*	BADGE KENWOOD KMWX	1	
B43-1046-04	N*	BADGE TRIO T	1	
B46-0415-00		USER & WARRANTY CARD K	1	
B48-0443-04	N*	LABEL FOR PACKAG	2	
B48-0444-04	N*	LABEL FOR PACKAG	2	
B48-0445-04	N*	LABEL FOR PACKAG	2	
B48-0446-04	N*	LABEL FOR PACKAG	2	
B50-8001-00	N	INSTRUCTION MANUAL KMWX	1	
B50-8002-00	N	INSTRUCTION MANUAL T	1	
CE04W1H010M		ELECTRO 1 50V	1	C 119
C90-0857-05		ELECTRO 22000 50V	2	C 108,109
C91-0496-05		CERAMIC 470P AC125V	2	C 102,103
C91-0647-05		CERAMIC 0.01 2KV	1	C 101
DSA441LA		SARGE ABSORBER	1	D 105
DTC124ES		DIGITAL TR NPN	1	Q 105
E04-0152-05		UMF. TYPE RECEPTACLE:ANT	1	J 102
E06-0655-05	N	DIN RECEPTACLE 6P ACC1	1	J 109
E06-0753-05	N	DIN RECEPTACLE 7P REMOTE	1	J 105
E06-0851-05		DIN RECEPTACLE 8P X-VERTER	1	J 104
E07-0751-05		DIN PLUG 7P (ACCESSARY)	1	
E07-0852-05		METAL PLUG 8P MIC MX	1	
E07-1351-05		PLUG ACC2 13P(ACCESSARY)	1	
E11-0404-05		PHONE JACK KEY,PHONE	2	J 101,108
E11-0410-05		PHONE JACK EXT SP	1	J 107
E13-0101-05		RCA JACK RX ANT,RTTY	2	J 103,106

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
E18-0351-05		3P AC SOCKET	1	J 110
E23-0015-04		LUG PLATE	3	
E23-0043-04		EARTH LUG ANT	1	
E23-0420-05		TERMINAL(INSIDE)	2	
E23-0423-05		LUG TERMINAL	4	
E30-1643-15		AC CORD ASS'Y M	1	
E30-1644-15		AC CORD ASS'Y T	1	
E30-1645-05		AC CORD ASS'Y W	1	
E30-1647-05		AC CORD ASS'Y X	1	
E30-2013-05	N	AC CORD ASS'Y K	1	
E40-0273-05		MINI CONNECTOR 2P	2	
E40-0773-05		MINI CONNECTOR 7P	1	
E40-3007-05		MINI CONNECTOR 2P	1	
F05-4022-05		FUSE 4A MTWX	2	
F05-4021-05		FUSE 6A KM	2	
F07-0862-04	N*	SLIDE COVER FOR TOP CASE	1	
F07-0863-03	N*	HEAT SINK COVER	1	
F09-0405-34		FAN :POWER TRANS SIDE	1	
F15-0656-14	N*	SWITCH MASK VOX	1	
F15-0657-04	N*	FILTER DISPLAY	1	
F19-0620-04	*	SHIELDING SLIDE COVER	2	
F20-0520-04		INSULATING SHEET (BATT TOP)	1	
F20-0521-04		INSULATING SHEET ( SP BOTTOM )	2	
F20-0527-05	*	INSULATING BOARD :TRANSISTOR	2	
F29-0421-14		INSULATOR	5	
G01-0817-04	*	COILED SPRING	4	
G02-0549-04		SPRING MOTOR	1	
G09-8403-05		SPRING FOR KNOB NB	1	
G09-0410-05		SPRING FOR KNOB VBT	1	
G11-0609-04	*	CUSHION MIC MX	2	
G13-0649-04	*	CUSHION (A) METER	2	
G13-0662-04	*	CUSHION SPEAKER	1	
G13-0810-04	N*	CUSHION CHEMI-CON BLOCK	2	
G13-0818-04		CUSHION	1	
G13-0819-04	N*	CUSHION	1	
G53-0510-04	*	PACKING PANEL	2	
G53-0511-04	*	PACKING LED	3	
G53-0524-04	N*	PACKING TOP CASE	1	
G53-0525-04	N*	PACKING FILTER CASE	1	
H01-4643-24	N*	CARTON (INSIDE) KMW	1	
H01-4644-24	N*	CARTON (INSIDE) T	1	
H01-4645-24	N*	CARTON (INSIDE) X	1	
H03-2248-24	N*	CARTON (OUTSIDE) KMTW	1	
H03-2252-24	N*	CARTON (OUTSIDE) X	1	
H10-1276-04	*	ACCESSARY BOX M	1	
H10-2602-02	N*	POLY' FIXTURE FRONT	1	
H10-2603-02	N*	POLY' FIXTURE REAR	1	
H12-0491-04	*	CUSHION KTWX	1	
H20-1426-03	N	PROTECTIVE BAG	1	
H25-0105-04	*	POLY BAG+DC CABLE	1	
H25-0120-04	*	BAG(CHARGER)	1	
J02-0049-14		FOOT REAR	2	
J02-0423-04		FOOT FRONT(OUT SIDE)	2	

# S-940S PARTS LIST

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
J02-0424-04		FOOT FRONT( IN SIDE)	2	
J02-0426-05		FOOT SMOLL TYPE	4	
J13-0033-15		FUSE HOLDER	1	F 101
J19-1363-05		LEAD HOLDER	2	
J21-4165-04	N*	HARDWARE FIXTURE(SLIDE COVER)	4	
J32-0762-04	*	STUD & BOSS (STICK TYPE)	1	
J32-0767-04	*	STUD & BOSS (STICK TYPE)	2	
J32-0789-04	N	STUD & BOSS MOTOR	1	
K01-0409-05		HANDLE	1	
K21-0764-04		KNOB RF,SQL,-----ETC	4	
K21-0765-04		KNOB PWR,PRD-OUT	2	
K21-0766-05		KNOB MAIN	1	
K23-0721-04		KNOB SQL	1	
K23-0740-04		KNOB AF,NOTCH,---ETC	4	
K23-0745-04		KNOB MIC,PRO-IN	2	
K23-0753-04		KNOB AGC,ATT,METER	3	
K23-0778-04	N	KNOB RIT/XIT	1	
K27-0433-04		PUSH KNOB NB	3	
K27-0435-04		PUSH KNOB RIT	5	
K29-0738-04		KNOB CW-VBT	1	
K29-0757-04		PUSH KNOB POWER	1	
K29-0761-04		KNOB LING MAIN	1	
K29-3002-04		PUSH KNOB VOX	4	
K29-3036-04		PUSH KNOB TIMER	1	
K29-3038-04	N	PUSH KNOB SEND/REC	3	
L01-0256-15	N	POWER TRANSFORME	1	T 101
L19-0356-05	N	TRANSFORMER	1	T 102
N09-0256-05		SCREW	2	
N09-0626-04		SEMS SCREW M3X10	3	
N09-0646-04		SCREW M4X4 HANDLE	2	
N09-0658-04		SCREW M2.6X3 MOTOR	2	
N10-2030-46		NUT,TR M3	4	
N14-0115-05		NUT GND	1	
N14-0509-05		NUT GND	1	
N14-0512-05		SPEED NUT SLIDE COVER	1	
N15-1026-46		FLAT WASHER M2.6	4	
N15-1030-41		FLAT WASHER M2.6	2	
N15-1030-46		FLAT WASHER,TR,SP	4	
N15-1040-46		FLAT WASHER M4	2	
N30-2004-45		PAN HD SCREW M2X4	2	
N30-2604-45		PAN HD SCREW M2.6X4	8	
N30-2604-46		PAN HD SCREW M2.6X4	24	
N30-2605-46		PAN HD SCREW M2.6X5	8	
N30-2606-46		PAN HD SCREW M2.6X6	2	
N30-2608-46		PAN HD SCREW M2.6X8	5	
N30-3004-46		PAN HD SCREW M3X4	1	
N30-3006-46		PAN HD SCREW M3X6	2	
N30-3014-46		PAN HD SCREW M3X14	4	
N30-4014-46		PAN HD SCREW M4X14	1	
N30-4016-46		PAN HD SREW M4X16 GND	1	
N32-2606-46		FLAT HD SCREW M2.6X6	4	
N32-3006-46		FLAT HD SCREW M3X6	14	
N32-3008-46		FLAT HD SCREW M3X8	2	
N33-3006-45		ROUND FLAT SCREW M3X6	2	

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
N35-3004-45		BIND SCREW M3X4	1	
N35-3006-41		BIND SCREW,SUB PANEL	4	
N35-3006-45		BIND SCREW M3X6	2	
N35-3008-45		BIND SCREW M3X8	3	
N35-4008-41		BIND SCREW M4X8	17	
N87-2606-46		TAPPING SCREW M2.6X6	18	
N87-3006-46		TAPPING SCREW,FOOT	61	
N87-3010-46		TAPPING SCREW M3X10	3	
N87-3012-46		TAPPING SCREW FINAL UNIT	29	
N87-4010-46		TAPPING SCREW M4X10	4	
N88-3006-46		FLAT TAPPING SCREW M3X6	6	
N89-3005-46		BIND TAPPING SCREW M3X5	9	
N89-3006-45		BIND TAPPING SCREW M3X6	15	
R90-0241-05		CAP. BLOCK 0.01UF X6	2	IB 101,102
S02380		LED GREEN	1	D 102
S19VB10		DIODE	1	D 101
S29-2406-05		SWITCH AC SELECTOR	1	S 103
S31-1407-05		SLIDE SWITCH	1	S 102
S40-2418-05		PUSH SWITCH POWER	1	S 101
S50-1406-05		TACT SWITCH MIC (UP/DOWN) HX	2	
S59-0433-15	N	KEYBOARD ASS'Y	1	
TC4001BP		C.MOS IC	1	IC 102
T07-0221-05		SPEAKER	1	
T42-0302-05		DC MOTOR FAN	1	M 3
T91-0352-05	N	MIC HX	1	
UPC7805H		AVR IC 5.V	1	IC 101
W02-0328-10		MAIN ENCODER ASS'Y	1	
W02-0368-05	N	LCD ASS'Y	1	
W09-0326-05		LITHIUM BATTERY BR2032	3	
X41-1600-00	N*	SW UNIT A/13 TO M/13	1	
X43-1500-00	N*	AVR UNIT	1	
X44-1660-00	N*	RF UNIT	1	
X45-1400-00	N*	100W FINAL UNIT	1	
X46-1030-00	N*	DC-DC UNIT	1	
X48-1430-00	N*	IF UNIT A/2,B/2 UNIT	1	
X50-2020-00	N*	PLL UNIT	1	
X51-1330-00	N*	FILTER UNIT	1	
X53-1420-11	N*	CONTROL UNIT	1	
X54-1690-01	N*	RIT ENCODER	1	
X54-1830-00	N*	DIGITAL A UNIT	1	
X54-1840-00	N*	DIGITAL B UNIT A/2,B/2 UNIT	1	
X54-1850-00	N*	DIGITAL C UNIT	1	
X57-1130-00	N*	AT UNIT "WITH/AT"ONLY	1	
1SS133		DIODE	3	D 103,104,106
2N5885		TR	2	Q 101,102
2SD1266(P,Q)		TR	1	Q 103
2SD1406(Y)	N	TR	1	Q 104
STP-41L			1	TH 101

# PARTS LIST TS-940S

**SW UNIT (X41-1600-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH1H220J		CERAMIC 22P 50V	2	C 3, 4
CC45SL1H330J		CERAMIC 33P 50V	1	C 1
CE04W1A100M		ELECTRO 10 10V	1	C 8
CE04W1E220M		ELECTRO 22 25V	1	C 7
CE04W1H2R2M		ELECTRO 2.2 50V	1	C 10
CK45F1H103Z		CERAMIC 0.01 50V	3	C 9, 11, 12
CS15E1A100M		TANTALUM 10 10V	1	C 2
C91-0117-05		CERAMIC 0.01 50V	1	C 6
C91-0119-05		CERAMIC 0.047 50V	1	C 5
DTA143ES	N	DIGITAL TR PNP	1	Q 5
DTC124EF		DIGITAL TR NPN	1	Q 4
DTC124ES		DIGITAL TR NPN	2	Q 1, 3
E06-0858-05		BP METAL SOCKET	1	J 2
E06-1351-05		ROUND TYPE CONNECTOR 13P	1	J 3
E13-0462-05	N	JACK 4P	1	J 1
E23-0512-05		TERMINAL 1P	3	
E40-0273-05		MINI CONNECTOR 2P	10	
E40-0274-05		MINI CONNECTOR 2P	2	
E40-0373-05		MINI CONNECTOR 3P	8	
E40-0473-05		MINI CONNECTOR 4P	5	
E40-0573-05		MINI CONNECTOR 5P	3	
E40-0673-05		MINI CONNECTOR 6P	4	
E40-0773-05		MINI CONNECTOR 7P	2	
E40-0873-05		MINI CONNECTOR 8P	4	
E40-0973-05		MINI CONNECTOR 9P	1	
E40-0974-05		MINI CONNECTOR 9P	1	
E40-1073-05		MINI CONNECTOR 10P	1	
J31-0502-04	*	COLLAR PC BOARD	7	
J42-0428-05	*	BUSHING PC BOARD	7	
L40-1001-12		INDUCTOR 10 UH	1	L 2
L40-4701-14		INDUCTOR 47 UH	1	L 3
L77-1256-05		XTAL 32.758KHZ	1	X 1
MC911		DIODE	1	D 29
MTZ10J		ZENER DIODE 10 V	1	D 20
MTZ11JC		ZENER DIODE 11 V	1	D 24
RC05GF2H100J		RES. SOLID 10 OHM 1/2W	1	R 56
RS14AB3A180J		METAL FILM 18 OHM 1W	1	R 55
R01-0407-05	N	POTENTIOMETER 300(B)	1	R 7
R12-1434-05		TRIM. POT. 5K OHM	1	VR 13
R13-3403-05	N	SLIDE POT. 10K(B)	2	R 4, 5
R13-3404-05	N	SLIDE POT. 10K(A)	1	R 6
R13-6402-05	N	SLIDE POT. 470K(B)	2	R 2, 3
R19-3413-05		POTENTIOMETER 10K(A), 10K(B)	1	R 12
R19-3421-05	N	POTENTIOMETER 100K(C)X2	1	R 10
R19-3422-05	N	POTENTIOMETER 10K(A), 10K(B)	1	R 8
R24-3403-05	N	POTENTIOMETER 10K(A) 10K(B)X2	1	R 9
R24-9402-05		POTENTIOMETER 10K(B), 10K(F)	1	R 11
R90-0515-05		RESISTOR BLOCK 10K OHM X4	2	IB 4, 6
R90-0534-05		RESISTOR BLOCK 10K OHM X5	1	IB 5
R90-0545-05		CAP. BLOCK 0.001 X4	1	IB 3

[illegible]

# TS-940S PARTS LIST

## AVR UNIT (X43-1500-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
BZ-320		ZENER DIODE 32 V	1	D 3
CE04W1A470M		ELECTRO 47 10V	3	C 9, 10, 11
CE04W1E100M		ELECTRO 10 25V	1	C 8
CE04W1E101M		ELECTRO 100 25V	1	C 14
CE04W1E220M		ELECTRO 22 25V	1	C 13
C90-0858-05		ELECTRO 2200 50V	2	C 3, 4
C90-0859-05		ELECTRO 2200 35V	1	C 6
C90-2014-05		ELECTRO 4800 16V	1	C 12
C91-0117-05		CERAMIC 0.01 50V	1	C 5
C91-0119-05		CERAMIC 0.047 50V	1	C 7
E23-0453-05		TERMINAL	2	
E23-0462-05	N	TERMINAL	5	
E40-0273-05		MINI CONNECTOR 2P	7	
E40-0373-05		MINI CONNECTOR 3P	4	
E40-0473-05		MINI CONNECTOR 4P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
F05-1534-05		FUSE 15A	1	F 1
J31-0502-04	*	COLLAR PC BOARD	4	
J42-0428-05	*	BUSHING PC BOARD	4	
L40-1511-03		INDUCTOR 150 UH	3	L 1, 2, 3
MTZ12JC		ZENER DIODE 12 V	1	D 4
MTZ18JC		ZENER DIODE 18 V	1	D 8
MTZ22JD		ZENER DIODE 22 V	1	D 14
MTZ9-1JA		ZENER DIODE 9.1V	1	D 9
RC05GF2H561J		RES. SOLID 560 OHM 1/2W	1	R 21
RS14AB3A2R2J		METAL FILM 2.2 OHM 1W	3	R 1, 2, 4
RS14GB3A821J		METAL FILM 820 OHM 1W	1	R 19
R12-0429-05		TRIM.POT. 500 OHM	1	VR 1
R92-0620-05		CEMENT RESISTOR 15M OHM 5W	1	R 9
SV03YS		VARISTOR	1	D 6
U05B		DIODE	6	D 1, 2, 10, 11, 12, 13
1SS133		DIODE	2	D 5, 6
2SB861(C)		TR	1	Q 1
2SC1959(Y)		TR	1	Q 5
2SC2235(O)		TR	1	Q 6
2SC2458(Y)		TR	3	Q 2, 3, 4

## RF UNIT (X44-1660-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH1H010C		CERAMIC 1P 50V	1	C 106
CC45CH1H101J		CERAMIC 100P 50V	1	C 4
CC45CH1H150J		CERAMIC 15P 50V	1	C 3
CC45CH1H220J		CERAMIC 22P 50V	3	C 183, 185, 186
CC45CH1H470J		CERAMIC 47P 50V	1	C 2
CC45CH1H560J		CERAMIC 56P 50V	1	C 6
CC45RH1H010C		CERAMIC 1P 50V	1	C 89
			3	96, 154, 155
CC45RH1H020C		CERAMIC 2P 50V	1	C 152
CC45RH1H030C		CERAMIC 3P 50V	1	C 128
CC45RH1H070D		CERAMIC 7P 50V	1	C 119
CC45RH1H100D		CERAMIC 10P 50V	5	C 50, 52, 64, 93, 138
			1	137
CC45RH1H120J		CERAMIC 12P 50V	3	C 142, 143, 147
CC45RH1H121J		CERAMIC 120P 50V	4	C 14, 40, 116, 118
CC45RH1H180J		CERAMIC 18P 50V	1	C 117
CC45RH1H181J		CERAMIC 180P 50V	2	C 31, 33
CC45RH1H220J		CERAMIC 22P 50V	2	C 144, 148
CC45RH1H221J		CERAMIC 220P 50V	2	C 25, 27
CC45RH1H270J		CERAMIC 27P 50V	4	C 58, 62, 139, 149
CC45RH1H390J		CERAMIC 39P 50V	2	C 51, 56
CC45RH1H470J		CERAMIC 47P 50V	2	C 5, 85
CC45RH1H560J		CERAMIC 56P 50V	3	C 39, 41, 57
CC45RH1H680J		CERAMIC 68P 50V	3	C 38, 45, 63
CC45RH1H820J		CERAMIC 82P 50V	2	C 44, 46
CC45SL1H020C		CERAMIC 2P 50V	1	C 104
CC45SL1H030C		CERAMIC 3P 50V	2	C 108, 67
CC45SL1H101J		CERAMIC 100P 50V	3	C 37, 91, 180
CC45SL1H150J		CERAMIC 15P 50V	1	C 105
CC45SL1H220J		CERAMIC 22P 50V	1	C 92
CC45SL1H330J		CERAMIC 33P 50V	3	C 159, 162, 168
CC45SL1H331J		CERAMIC 330P 50V	1	C 18
CC45SL1H680J		CERAMIC 68P 50V	1	C 99
CC45SL1H681J		CERAMIC 680P 50V	1	C 23
CC45SL1H820J		CERAMIC 82P 50V	1	C 90
CC45TH1H220J		CERAMIC 22P 50V	1	C 146
CC45TH1H270J		CERAMIC 27P 50V	1	C 141
CC45TH1H330J		CERAMIC 33P 50V	1	C 136
CE04BW1E010M		ELECTRO 1 25V	1	C 191
CE04W1E220M		ELECTRO 22 25V	11	C 7, 12, 21, 29, 35, 43, 48, 54, 60, 66
				80
CE04W1E47M		ELECTRO 4.7 25V	1	C 127
CE04W1E470M		ELECTRO 47 25V	2	C 83, 121
CE04W1H010M		ELECTRO 1 50V	1	C 114
CK45B1H471K		CERAMIC 470P 50V	4	C 187, 188, 189, 190
CQ92M1H102K		MYLAR 0.001 50V	1	C 16
CQ92M1H152K		MYLAR 0.0015 50V	2	C 15, 17
C90-0506-05		ELECTRO 0.22 50V	1	C 75
C90-0817-05		ELECTRO 1000 16V	1	C 134
C91-0117-05		CERAMIC 0.01 50V	2	C 100, 101
C91-0119-05		CERAMIC 0.047 25V	45	C 8, 9, 10, 11, 20, 28, 30, 34, 36, 42
				47, 49, 53, 55, 59, 61, 65, 67, 68, 69
				70, 72, 73, 74, 76, 77, 78, 79, 81, 82
				84, 86, 87, 109, 112, 113, 115, 122, 123, 124
				128, 166, 169, 177, 178
C91-0667-05		CERAMIC 0.0047 50V	3	C 94, 95, 107



# PARTS LIST TS-940S

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
C91-1008-05		CERAMIC 0.022 50V	5 1	C 131, 132, 133, 157, 158 163
DTA143XS		DIGITAL TR PNP	1	A 14
E04-0154-05		RF COAX. CONNECTOR	9	
E23-0430-05		TERMINAL	1	
E40-0211-05		MINI CONNECTOR 2P	1	
E40-0273-05		MINI CONNECTOR 2P	4	
E40-0373-05		MINI CONNECTOR 3P	1	
E40-0473-05		MINI CONNECTOR 4P	3	
E40-0573-05		MINI CONNECTOR 5P	1	
GM-3B		DIODE	1	D 44
L19-0324-05		TOROIDAL	3	T 1, 2, 3
L19-0335-05		TOROIDAL	1	T 4
L19-0347-05		TRANSFORMER 5.5T	1	T 5
L32-0651-05		OSC COIL	1	L 65
L32-0652-05		OSC COIL	1	L 68
L32-0653-05		OSC COIL	1	L 71
L33-0658-05		CHOKE COIL	2	L 82, 83
L33-0685-05		CHOKE COIL	1	L 84
L34-0691-05	N	TUNING COIL	1	L 86
L34-1124-05		COIL 5 6.5T	2	L 1, 42
L34-2074-05		TUNING COIL	1	L 45
L34-2080-05		TUNING COIL	1	L 2
L34-2081-05		TUNING COIL	1	L 5
L34-2082-05		TUNING COIL	1	L 6
L34-2083-05		TUNING COIL	1	L 9
L34-2085-05		TUNING COIL	1	L 11
L34-2086-05		TUNING COIL	1	L 12
L34-2087-05		TUNING COIL	1	L 13
L34-2088-05		TUNING COIL	1	L 14
L34-2089-05		TUNING COIL	1	L 15
L34-2090-05		TUNING COIL	1	L 16
L34-2091-05		TUNING COIL	1	L 18
L34-2092-05		TUNING COIL	1	L 19
L34-2093-05		TUNING COIL	2	L 20, 21
L34-2094-05		TUNING COIL	1	L 22
L34-2095-15		TUNING COIL	1	L 23
L34-2096-05		TUNING COIL	1	L 24
L34-2097-05		TUNING COIL	1	L 7
L34-2098-05		TUNING COIL	1	L 10
L34-2101-05		TUNING COIL	1	L 29
L34-2106-05		TUNING COIL	2	L 74, 76
L34-2107-05		TUNING COIL	1	L 75
L34-2109-15		TUNING COIL	1	L 60
L34-2111-05		TUNING COIL	2	L 53, 57
L34-2112-05		TUNING COIL	1	L 54, 56
L34-2113-05		TUNING COIL	1	L 55
L34-2114-15		TUNING COIL	1	L 50, 51, 52
L34-2161-15		TUNING COIL	1	L 40
L34-2241-05	N	TUNING COIL	2	L 25, 27
L34-2242-05	N	TUNING COIL	1	L 24
L34-2243-05	N	TUNING COIL	2	L 28, 30
L34-2244-05	N	TUNING COIL	2	L 31, 33

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
L34-2245-05	N	TUNING COIL	1	L 32
L34-2247-05		TUNING COIL	2	L 44, 46
L40-1011-03		INDUCTOR 100 UH	2	L 61, 62
L40-1021-03		INDUCTOR 1 MH	2	L 3, 41
L40-1092-13		INDUCTOR 1 UH	1	L 85
L40-1811-03		INDUCTOR 180 UH	1	L 59
L40-2201-03		INDUCTOR 22 UH	2	L 70, 72
L40-2701-03		INDUCTOR 27 UH	2	L 67, 69
L40-3301-03		INDUCTOR 33 UH	2	L 64, 66
L40-3391-03		INDUCTOR 3.3 UH	1	L 80
L40-4701-03		INDUCTOR 47 UH	6	L 47, 63, 73, 77, 78, 79
L40-4701-14		INDUCTOR 47 UH	1	L 43
L40-4711-03		INDUCTOR 470 UH	6	L 4, 34, 35, 37, 38, 39
L40-5691-02		INDUCTOR 5.6 UH	1	L 58
L40-8291-02		INDUCTOR 8.2 UH	1	L 17
MC911		DIODE	1	D 40
MT204		DIODE	2	D 23, 26
MT216JA		ZENER DIODE 16 V	1	D 34
MT23.0JB		ZENER DIODE 3.0V	1	D 27
MT23.6JB		ZENER DIODE 3.6V	1	D 22
MT25.1JA		ZENER DIODE 5.1V	1	D 48
MV-203		VARIATOR	1	D 25
RC05GF2H221J		RES. SOLID 220 OHM 1/2W	2	R 6, 15
RC05GF2H331J		RES. SOLID 330 OHM 1/2W	1	R 5
RC05GF2H471J		RES. SOLID 470 OHM 1/2W	1	R 144
RC05GF2H821J		RES. SOLID 820 OHM 1/2W	1	R 31
RS14A83D470J		METAL FILM 47 OHM 2W	2	R 134, 135
R12-1429-05		TRIM.POT. 500 OHM	2	VR 2, 3
R12-3443-05		TRIM.POT. 10K OHM	1	VR 1
R90-0593-05	N	RESISTOR BLOCK 2.2KOHM X9	1	RB 1
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 1
S51-1414-05		RELAY	1	RL 4
S51-1420-05		RELAY	3	RL 1, 2, 3
1SS133		DIODE	11	D 28, 29, 30, 31, 32, 41, 42, 43, 45, 46 47
1SV54GC		VOLTAGE VARIABLE	3	D 35, 36, 38
1S1587		DIODE	3	D 35, 37, 39
1S2588		DIODE	21	D 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 21
2SA1048(Y)		TR	2	Q 13, 26
2SC1907		TR	3	Q 5, 19, 20, 22, 23
2SC1973(T)		TR	1	Q 9
2SC2053		TR	1	Q 6
2SC2458(Y)		TR	5	Q 15, 24, 25, 27, 28
2SC2668(Y)		TR	1	Q 21
2SK125		FET	2	Q 7, 8
2SK125P		FET PAIR	2	Q 9, 10
2SK192A(GR)*J		FET	3	Q 16, 17, 18
3SK73(GR)		FET	3	Q 1, 2, 3

# 'S-940S PARTS LIST

**100W FINAL UNIT (X45-1400-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
BZ-192		ZENAR DIODE 19 V	1	D 5
BZ-350		ZENAR DIODE 35 V	1	D 1
CC455L1H271J		CERAMIC 270P 50V	1	C 35
CC455L1H331J		CERAMIC 330P 50V	2	C 2, 9
CC455L2H101J		CERAMIC 100P 500V	2	C 8, 42
CE04W1A471M		ELECTRO 470 10V	1	C 18
CE04W1H100M		ELECTRO 10 50V	1	C 12
CE04W1H101M		ELECTRO 100 50V	1	C 24
CK45F1H103Z		CERAMIC 0.01 50V	2	C 23, 43
CM73F2H331J		CHIP CAP. 330P 500V	1	C 33
CM73F2H391J		CHIP CAP. 390P 500V	1	C 38
CM73F2H681J		CHIP CAP. 680P 500V	1	C 28
C91-0456-05		CERAMIC 0.047 25V	11	C 1, 3, 5, 11, 20, 21, 25, 26, 27, 36
C91-0491-05		CHIP CAP. 0.0047	2	C 57
C91-0493-05		CHIP CAP. 0.47	2	C 16, 17
E23-0015-04		LUG PLATE	1	
E23-0433-05		LUG	8	
F01-0927-05	N*	HEAT SINK	1	
F07-0864-03	N*	HEAT SINK COVER	1	
F09-0410-04	N*	FAN	1	
F19-0644-04	N*	SHIELDING MESH	1	
F20-0078-05		INSULATING PLATE	6	
F29-0014-05		INSULATING WASHER TRANSISTOR	10	
G02-0549-04		SPRING MOTOR	1	
J21-4167-14	N*	HARDWARE FIXTURE	1	
J21-4168-14	N*	HARDWARE FIXTURE	1	
L19-0337-05		TRANSFORMER	1	T 2
L19-0338-05		TRANSFORMER	1	T 3
L19-0339-05		TRANSFORMER B	1	T 4
L19-0340-05		TRANSFORMER A	1	T 1
L33-0025-05		CHOKE COIL 1 UH	2	L 4, 5
L33-0032-05		CHOKE COIL 3 UH	1	L 2
L33-0617-05		RFC COIL	4	L 3, 7, 8, 9
L33-0644-05		CHOKE COIL 2.2 UH	1	L 17
L33-0651-05		CHOKE COIL	2	L 14, 15
L33-0653-05		CHOKE COIL	1	L 16
L33-0655-05		CHOKE COIL	1	L 13
L40-1011-04		INDUCTOR 100 UH	1	L 10
L40-1511-03		INDUCTOR 150 UH	4	L 6, 11, 12, 18
MC1723CL		AVR IC	1	IC 1
MRF422		TR	2	Q 4, 5
MRF485		TR	2	Q 2, 3
N09-0623-04		SEMS SCREW M3X8	4	
N09-0643-04		SCREW SEMUSE	1	
N09-0658-04		SCREW M2.6X3 MOTOR	2	
N35-3006-46		BIND SCREW,CASE(BOTTOM)	5	
N35-3008-46		BIND SCREW M3X8	5	

[illegible]



**DC-DC UNIT (X46-1030-00)**

[illegible]

**IF UNIT (X48-1430-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
BA718		DUAL OP-AMP	2	IC 1, 2
CC45CH1HOR5C		CERAMIC 0.5P 50V	2	C 15,265
CC45CH1HO10C		CERAMIC 1P 50V	1	C 282
CC45CH1HO20C		CERAMIC 2P 50V	2	C 23,278
CC45CH1H100D		CERAMIC 10P 50V	3	C 1,178,256
CC45CH1H330J		CERAMIC 33P 50V	2	C 7, 22
CC45RH1HO10C		CERAMIC 1P 50V	3	C 8, 9, 10
CC45RH1H121J		CERAMIC 120P 50V	1	C 165
CC45RH1H241J		CERAMIC 240P 50V	1	C 163
CC45SL1H101J		CERAMIC 100P 50V	8	C 3, 4, 26,131,181,187,189,224
CC45SL1H121J		CERAMIC 120P 50V	2	C 118,211
CC45SL1H151J		CERAMIC 150P 50V	2	C 91,220
CC45SL1H221J		CERAMIC 220P 50V	2	C 125,176
CC45SL1H391J		CERAMIC 390P 50V	1	C 113
CC45SL1H470J		CERAMIC 47P 50V	1	C 124
CC45SL1H560J		CERAMIC 56P 50V	1	C 11
CC45UJ1H101J		CERAMIC 100P 50V	1	C 185
CE04WA470M		ELECTRO 47 10V	1	C 25
CE04WC330M		ELECTRO 33 16V	17	C 21, 28, 97,105,137,138,145,150,153,190
				194,196,207,208,227,232,275
CE04WE1220M		ELECTRO 22 25V	1	C 206
CE04WH47M		ELECTRO 0.47 50V	2	C 132,144
CE04WH0R1M		ELECTRO 0.1 50V	3	C 123,126,128
CE04WH010M		ELECTRO 1 50V	18	C 61, 63, 65, 68, 70, 72, 75,103,130,139
				149,188,192,195,197,199,209,281
CE04WH100M		ELECTRO 10 50V	8	C 140,141,142,151,191,198,201,202
CE04WH47M		ELECTRO 4.7 50V	1	C 226
CQ09FS1H122J	N	POLYSTYRENE 1200P 50V	3	C 174,177,179
CQ09FS1H182J	N	POLYSTYRENE 1800P 50V	2	C 87, 88
CQ09FS1H392J	N	POLYSTYRENE 3900P 50V	2	C 112,162
CQ92MH1273K		MYLAR 0.027 50V	1	C 146
CQ92MH1392K		MYLAR 0.0039 50V	2	C 83,107
CQ92MH1473K		MYLAR 0.047 50V	1	C 147
CQ92MH1683K		MYLAR 0.068 50V	1	C 143
C05-0314-05		TRIMMER 100P	1	TC 1
C90-0495-05		FIXED ELECTRO 47 6.3V	1	C 402
C91-0117-05		CERAMIC 0.01 50V	28	C 2, 12, 13, 18, 20, 24, 27, 41, 48, 53
				66, 78, 89,106,122,148,152,172,200,241
				247,249,261,272,273,276,277,401
C91-0119-05		CERAMIC 0.047 25V	62	C 19, 43, 44, 45, 49, 55, 56, 57, 58, 60
				62, 64, 67, 69, 71, 76, 77, 82, 84, 86
				90, 93, 95, 96,101,104,109,111,114,116
				117,119,134,156,159,160,164,166,167,168
				169,171,173,175,182,183,184,186,213,214
				215,217,221,223,228,229,230,231,236,238
				238
				239,280
C91-0457-05		CERAMIC 0.022 50V	22	C 16, 17, 40, 42, 59, 81, 94, 98,102,127
				154,157,158,216,246,248,252,257,260,267
C91-0667-05		CERAMIC 0.0047 50V		C 269,274
			2	C 14,206
C91-0671-05		CERAMIC 0.0068 50V	3	C 135,136,193
C91-1008-05		CERAMIC 0.022 50V	41	C 5, 6, 29, 30, 31, 32, 34, 35, 36, 37
				39, 47, 51, 52, 54, 74, 79, 80, 85, 92

# S-940S PARTS LIST

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
				180, 212, 219, 235, 237, 240, 242, 243, 244, 250 251, 253, 254, 258, 259, 262, 263, 264, 266, 270 271
DTA143EF	N	DIGITAL TR PNP	14	Q 401, 402, 403, 404, 405, 406, 407, 408, 409, 410 411, 412, 413, 414
DTC114ES		DIGITAL TR NPN	5	Q 3, 6, 18, 20, 38
E04-0154-05		RF COAX. CONNECTOR	3	
E29-0440-14		GND WAFER	2	
E40-0211-05		MINI CONNECTOR 2P	1	
E40-0273-05		MINI CONNECTOR 2P	7	
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	9	
E40-0573-05		MINI CONNECTOR 5P	3	
E40-0611-05		MINI CONNECTOR 6P	1	
E40-0618-05		CONNECTOR 6P	1	
E40-0711-05		MINI CONNECTOR 7P	2	
E40-0718-05		CONNECTOR 7P	2	
E40-0811-05		MINI CONNECTOR 8P	1	
E40-0818-05		CONNECTOR 8P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
E40-0973-05		MINI CONNECTOR 9P	2	
E40-5059-05	N	MINI CONNECTOR 5P	6	
J32-0761-04	*	STUD & BOSS (STICK TYPE)	6	
L78001P		LED RED	2	D 48, 51
L32-0650-15		OSCILLATING COIL	4	L 15, 18, 19, 20
L34-0536-05		TUNING COIL	5	L 1, 8, 37, 38, 41
L34-0781-05		TUNING COIL	5	L 2, 35, 40, 42, 43
L34-0942-05		TUNING COIL	2	L 9, 10
L34-0943-05		TUNING COIL	4	L 7, 11, 36, 44
L34-2114-15		TUNING COIL	1	L 46
L34-2117-15		TUNING COIL	1	L 45
L34-2124-05		TUNING COIL	1	L 13
L34-2125-05		TUNING COIL	7	L 12, 14, 29, 31, 32, 33, 34
L34-2125-15		TUNING COIL	3	L 23, 24, 25
L34-2127-15		TUNING COIL	1	L 16
L34-2128-15		TUNING COIL	1	L 17
L34-2247-05	N	TUNING COIL	4	L 3, 4, 5, 6
L40-1021-03		INDUCTOR 1 MH	3	L 26, 27, 28
L40-1211-03		INDUCTOR 120 UH	1	L 39
L40-1541-27		INDUCTOR 150 MH	2	L 21, 22
L40-4715-25		INDUCTOR 10 UH	1	L 30
L71-0222-05		MCF YK-88S1	1	XF 2
L71-0254-05	N	MCF 45.05MHZ	1	XF 1
L72-0319-05		CERAMIC FILTER CFW455HT	1	CF 2
L72-0333-05		CERAMIC FILTER CFJ455K12	1	CF 1
L72-0350-05		CERAMIC FILTER 9285KHZ	1	CF 3
MC911		DIODE	2	D 102, 103
MC921		DIODE	5	D 43, 40, 69, 74, 82
			5	63, 97, 105, 106, 107
MC931		DIODE	5	D 46, 47, 74, 80, 109
MTZ10J		ZENER DIODE 10 V	3	D 45, 66, 71
MTZ12JC		ZENER DIODE 12 V	1	D 112

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
MTZ3.9J		ZENER DIODE 3.9V	2	D 25, 37
MTZ4.3J		ZENER DIODE 4.3V	1	D 75
MTZ5.1(A,B)		ZENER DIODE 5.1V	1	D 401
MTZ6.2JB		ZENER DIODE 6.2V	1	D 55
MTZ6.8J		ZENER DIODE 6.8V	1	D 2
MV203		VARISTOR	2	D 65, 90
ND487R1-3R		D.B.M	1	D 73
N30-3010-46		PAN HD SCREW TR	6	
RN14BK2E271F		METAL FILM 270 OHM 1/4W	2	R 232, 233
R12-0421-05		TRIM.POT. 100 OHM	1	VR 6
R12-1428-05		TRIM.POT. 1K OHM	1	VR 1
R12-1429-05		TRIM.POT. 500 OHM	2	VR 8, 10
R12-3443-05		TRIM.POT. 10K OHM	2	VR 3, 9
R12-3450-05		TRIM.POT. 20K OHM	1	VR 5
R12-4413-05		TRIM.POT. 50K OHM	1	VR 2, 4, 7
R90-0588-05	N	RESISTOR BLOCK 2.2KOHM X6	1	R 403
R90-0589-05	N	RESISTOR BLOCK 2.2KOHM X4	1	R 402
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 401
TA7140P		IC MIC AMP	1	IC 3
TA7302P		IC PROC AMP	1	IC 4
1N60		DIODE	4	D 39, 40, 41, 42
1SS133		DIODE	54	D 14, 15, 16, 17, 30, 31, 32, 33, 49, 50
			8	52, 53, 54, 56, 57, 58, 59, 61, 62, 64
				17, 50, 52, 54, 58, 59, 61, 64
				67, 68, 70, 81, 88, 89, 91, 92, 93, 94
				95, 96, 98, 99, 100, 101, 104, 108, 110, 111
				402, 403, 404, 405, 406, 407, 408, 409, 410, 411
				412, 413, 414, 415
1SV149A	N	VOLTAGE VARIABLE DIODE	2	D 38, 44
1SV1587			34	D 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
				13, 18, 19, 20, 21, 22, 23, 24, 26, 27
				28, 29, 34, 35, 36, 72, 77, 78, 79, 83
				84, 85, 86, 87
				1, 2, 4, 6
112-103-2		THERMISTOR 10K OHM	4	TH 1
112-501-2		THERMISTOR 500 OHM	1	TH 5
112-503-2		THERMISTOR 50K OHM	1	TH 3
2SA1048(Y)		TR	1	Q 25
			1	42
2SC1959(Y)		TR	1	Q 35
2SC2458(Y)		TR	8	Q 14, 15, 17, 19, 24, 31, 32, 39
			4	28, 40, 41, 47
2SC2459(BL)		TR OR 2SC2240(GR)	3	Q 29, 30, 36
2SC2668(Y)		TR	1	Q 1
2SC2787(L)		TR	2	Q 9, 49
2SK125		FET	2	Q 4, 5
2SK192A(GR)		FET	2	Q 16, 53
2SK30A(GR)		FET	3	Q 21, 22, 23, 26, 27
3SK73(Y)		FET	16	Q 2, 7, 8, 10, 11, 12, 13, 34, 37, 43
				44, 45, 46, 48, 50, 51

# PARTS LIST TS-940S

## PLL UNIT (X50-2020-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
BA718	N	DUAL OP-AMP	1	IC 18
CC45CH1H010C		CERAMIC 1P 50V	1	C 198
CC45CH1H020C		CERAMIC 2P 50V	1	C 84
			1	140
CC45CH1H030C		CERAMIC 3P 50V	1	C 13
			4	40, 59, 139, 30
CC45CH1H050C		CERAMIC 5P 50V	2	C 6, 150
CC45CH1H060D		CERAMIC 6P 50V	1	C 204
CC45CH1H070D		CERAMIC 7P 50V	1	C 104
CC45CH1H080D		CERAMIC 8P 50V	1	C 149
			1	156
CC45CH1H090D		CERAMIC 9P 50V	1	C 191
CC45CH1H100D		CERAMIC 10P 50V	6	C 7, 132, 141, 153, 155, 203
			1	31
CC45CH1H120J		CERAMIC 12P 50V	1	C 39
			2	45, 114
CC45CH1H150J		CERAMIC 15P 50V	2	C 10, 151
CC45CH1H180J		CERAMIC 18P 50V	3	C 12, 14, 154
			2	217, 219
CC45CH1H220J		CERAMIC 22P 50V	4	C 2, 60, 122, 199
			4	125, 127, 136, 200
CC45CH1H270J		CERAMIC 27P 50V	1	C 41
CC45CH1H330J		CERAMIC 33P 50V	2	C 17, 58
			3	134, 144, 218
CC45CH1H390J		CERAMIC 39P 50V	1	C 135
CC45SL1H101J		CERAMIC 100P 50V	5	C 4, 123, 176, 178, 179
			1	177
CC45SL1H121J		CERAMIC 120P 50V	2	C 157, 158
CC45SL1H151J		CERAMIC 150P 50V	2	C 3, 164
			1	100
CC45SL1H181J		CERAMIC 180P 50V	1	C 42
CC45SL1H271J		CERAMIC 270P 50V	1	C 103
CC45SL1H390J		CERAMIC 39P 50V	2	C 101, 117
			1	113
CC45SL1H560J		CERAMIC 56P 50V	2	C 190, 192
CC45SL1H680J		CERAMIC 68P 50V	1	C 126
CC45SL1H820J		CERAMIC 82P 50V	1	C 115
CC45UJ1H020C		CERAMIC 2P 50V	1	C 64
			1	107
CC45UJ1H030C		CERAMIC 3P 50V	4	C 68, 85, 88, 108
CC45UJ1H040C		CERAMIC 4P 50V	1	C 63
CC45UJ1H050C		CERAMIC 5P 50V	1	C 65
CC45UJ1H150J		CERAMIC 15P 50V	1	C 86
CC45UJ1H390J		CERAMIC 39P 50V	1	C 66
CE04W1A470M		ELECTRO 47 10V	8	C 20, 21, 27, 95, 97, 111, 170, 172
CE04W1C330M		ELECTRO 33 16V	7	C 49, 71, 82, 93, 143, 201, 208
CE04W1H0R1M		ELECTRO 0.1 50V	1	C 22
CQ92M1H123K		MYLAR 0.012 50V	1	C 73
CQ92M1H223K		MYLAR 0.022 50V	1	C 90
CS15E1E010M		TANTALUM 1 25V	1	C 209
CS15E1VR22M		TANTALUM 0.22 35V	2	C 184, 185
CS15E1VR33M		TANTALUM 0.33 35V	2	C 186, 187
CS15E1VR47M		TANTALUM 0.47 35V	1	C 206
C05-0044-05		TRIM. CAP. 30P	1	TC 1
C91-0084-05		CERAMIC 0.0047 50V	1	C 215

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
C91-0117-05		CERAMIC 0.01 50V	30	C 5, 9, 16, 33, 34, 50, 76, 79, 81, 91
			6	94, 98, 102, 110, 128, 130, 131, 133, 145, 146
			2	106, 124, 129, 147, 159, 214
C91-0119-05		CERAMIC 0.047 25V	5	C 148, 162, 167, 173, 180, 181, 182, 183, 205, 211
			1	1, 29, 32, 188, 189
C91-0457-05		CERAMIC 0.022 50V	1	C 77
			1	212
C91-0667-05		CERAMIC 0.0047 50V	9	C 23, 67, 70, 74, 137, 165, 194, 195, 202
			3	62, 69, 138
C91-1008-05		CERAMIC 0.022 50V	19	C 8, 18, 26, 28, 37, 46, 47, 48, 53, 54
			5	55, 56, 80, 118, 119, 120, 121, 160, 168
			5	15, 44, 105, 174, 210
DTA124ES		DIGITAL TR PNP	1	Q 32
DTC124ES		DIGITAL TR NPN	2	Q 30, 31
E29-0434-05		CONNECTOR & TERM	1	
E40-0273-05		MINI CONNECTOR 2P	2	
E40-0373-05		MINI CONNECTOR 3P	1	
E40-0473-05		MINI CONNECTOR 4P	2	
E40-0573-05		MINI CONNECTOR 5P	2	
E40-0673-05		MINI CONNECTOR 6P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
HD10551	N	DIVIDER IC 1/10, 11, 20, 22, 40, 44	2	IC 5, 11
J31-0502-04	*	COLLAR PC BOARD	8	
J42-0428-05	*	BUSHING PC BOARD	8	
L32-0675-05	N	OSCILLATING COIL 38MHZ	1	L 7
L32-0676-05	N	OSCILLATING COIL 105MHZ	1	L 10
L32-0677-05	N	OSCILLATING COIL 36MHZ	1	L 34
L34-0692-05		COIL 5 4T	1	L 39
L34-0749-05		TUNING COIL	2	L 17, 18
L34-0859-05		TUNING COIL	3	L 25, 26, 27
L34-1124-05	N	COIL 5 6.5T	1	L 30
L34-2026-05		TUNING COIL	2	L 20, 21
L34-2116-15		TUNING COIL	2	L 5, 6
L34-2249-05	N	TUNING COIL	3	L 22, 23, 24
L40-1001-03		INDUCTOR 10 UH	4	L 4, 11, 14, 31, 32, 33
L40-1001-12		INDUCTOR 10 UH	3	L 36, 37, 38
L40-1011-03		INDUCTOR 100 UH	1	L 12
L40-1011-12		INDUCTOR 100 UH	1	L 29
L40-1092-02		INDUCTOR 1 UH	1	L 9
L40-1211-03		INDUCTOR 120 UH	1	L 13
L40-2205-25		INDUCTOR 22 UH	2	L 8, 35
L40-2701-03		INDUCTOR 27 UH	1	L 15
L40-2791-02		INDUCTOR 2.7 UH	1	L 28
L40-3301-03		INDUCTOR 33 UH	1	L 16
L40-3382-01		INDUCTOR 0.33UH	1	L 19
L40-4711-03		INDUCTOR 470 UH	1	L 2
L40-8291-02		INDUCTOR 8.2 UH	2	L 1, 3
L72-0349-05	N	CERAMIC FILTER SFJ10-7MA-D	1	CF 1
L77-0963-05		CRYSTAL 20MHZ	1	X 1
MC145158P	N	PLL IC	1	IC 17

# S-940S PARTS LIST

[illegible]

**FILTER UNIT (X51-1330-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH1H220J		CERAMIC 22P 50V	1 C	55
CC45CH1H470J		CERAMIC 47P 50V	1 C	54
CC45SL2H030C		CERAMIC 3P 500V	1 C	76
CC45SL2H050C		CERAMIC 5P 500V	1 C	23
CC45SL2H070D		CERAMIC 7P 500V	1 C	24
CC45SL2H101J		CERAMIC 100P 500V	6 C	11, 22, 30, 33, 38, 39
CC45SL2H120J		CERAMIC 12P 500V	1 C	27
CC45SL2H121J		CERAMIC 120P 500V	1 C	32
CC45SL2H150J		CERAMIC 15P 500V	2 C	28, 42
CC45SL2H151J		CERAMIC 150P 500V	4 C	10, 35, 37, 41
CC45SL2H181J		CERAMIC 180P 500V	2 C	31, 40
CC45SL2H220J		CERAMIC 22P 500V	4 C	8, 9, 74, 75
CC45SL2H221J		CERAMIC 220P 500V	5 C	14, 16, 25, 36, 46
CC45SL2H350J		CERAMIC 33P 500V	1 C	12
CC45SL2H351J		CERAMIC 330P 500V	3 C	2, 13, 49
CC45SL2H390J		CERAMIC 39P 500V	2 C	21, 48
CC45SL2H391J		CERAMIC 390P 500V	3 C	4, 34, 50
CC45SL2H470J		CERAMIC 47P 500V	4 C	15, 26, 43, 44
CC45SL2H471J		CERAMIC 470P 500V	3 C	18, 19, 53
CC45SL2H560J		CERAMIC 56P 500V	2 C	29, 52
CC45SL2H680J		CERAMIC 68P 500V	4 C	6, 45, 47, 51
CC45SL2H681J		CERAMIC 680P 500V	1 C	17
CC45SL2H820J		CERAMIC 82P 500V	2 C	7, 20
CE04H1H010M		ELECTRO 1 50V	1 C	63
CE04H1H100M		ELECTRO 10 50V	1 C	64
CH93D2H152J		MICA 1500P 500V	2 C	1, 5
CH93D2H222J		MICA 2200P 500V	1 C	3
C91-0119-05		CERAMIC 0.047 50V	3 C	58, 59, 60
DTC124ES		DIGITAL TR NPN	5	q 1, 2, 3, 5, 9
E04-0154-05		RF COAX. CONNECTOR	1	
E04-0157-05		RF COAX. CABLE RECEPTACLE	1	
E40-0273-05		MINI CONNECTOR 2P	1	
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	2	
F11-0891-02	N*	SHIELDING CASE	1	
J31-0502-04	*	COLLAR PC BOARD	8	
J42-0428-05	*	BUSHING PC BOARD	8	
L34-3038-05		FILTER COIL A 1.5- 2.5 MHZ	1 L	2
L34-3039-05		FILTER COIL B 1.5- 2.5 MHZ	1 L	1
L34-3041-05		FILTER COIL D 2.5- 4.5 MHZ	1 L	6
L34-3043-05		FILTER COIL F 4.5- 7.5 MHZ	1 L	14
L34-3051-15		FILTER COIL N 22- 30 MHZ	1 L	4
L34-3124-05	N	FILTER COIL P 2.5- 4.5 MHZ	1 L	5
L34-3125-05	N	FILTER COIL Q 4.5-7.5/7.5-10	2 L	10, 13
L34-3126-05	N	FILTER COIL R 7.5-10.5 MHZ	1 L	9
L34-3127-05	N	FILTER COIL S 22- 30 MHZ	1 L	3
L34-3128-05	N	FILTER COIL T 10.5-15.5 MHZ	1 L	11
L34-3129-05	N	FILTER COIL U 10.5-15.5 MHZ	1 L	12
L34-3130-05	N	FILTER COIL V 15.5-22.0 MHZ	2 L	7, 8
L39-0419-05		DETECTOR COIL	1 L	15
L39-0420-05	N	DETECTOR COIL C	1 L	16

# PARTS LIST TS-940S

[illegible]

**CONTROL UNIT (X53-1420-11)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45SL1H050C		CERAMIC 5P 50V	1	C 65
CC45SL1H100D		CERAMIC 10P 50V	1	C 66
CC45SL1H101J		CERAMIC 100P 50V	2	C 127,156,185
CC45SL1H120J		CERAMIC 12P 50V	2	C 107,108
CC45SL1H221J		CERAMIC 220P 50V	1	C 164
CC45SL1H330J		CERAMIC 33P 50V	2	C 126,130
CC45SL1H331J		CERAMIC 330P 50V	2	C 69, 72
CC45SL1H470J		CERAMIC 47P 50V	2	C 55,132
CE04W1A470M		ELECTRO 47 10V	1	C 89
CE04W1C100M		ELECTRO 10 16V	5	C 91,105,134,142,160
CE04W1C102M		ELECTRO 1000 16V	1	C 111
CE04W1C220M		ELECTRO 22 16V	6	C 4, 8, 30, 48, 50, 60
CE04W1C221M		ELECTRO 220 16V	1	C 157
CE04W1C330M		ELECTRO 33 16V	7	C 90, 97,129,136,153,155,159
CE04W1C470M		ELECTRO 47 14V	5	C 92,109,112,168,178
CE04W1E100M		ELECTRO 10 25V	3	C 2, 31,149
CE04W1E470M		ELECTRO 47 25V	4	C 173,176,177,179
CE04W1HR33M		ELECTRO 0.33 50V	1	C 180
CE04W1HR47M		ELECTRO 0.47 50V	7	C 11, 12, 17, 62, 77,145,158
CE04W1HOR1M		ELECTRO 0.1 50V	3	C 78, 96,172
CE04W1H010M		ELECTRO 1 50V	11	C 1, 3, 32, 33, 63,135,140,141,146,161
				171
CE04W1H3R3M		ELECTRO 3.3 50V	1	C 9
CE04W1H470M		ELECTRO 47 50V	1	C 49
CK45B1H152K		CERAMIC 1500P 50V	1	C 133
C092M1H102K		MYLAR 0.001 50V	2	C 104,124
C092M1H105K		MYLAR 0.01 50V	5	C 13, 15, 76, 84, 85
C092M1H124K		MYLAR 0.1 50V	1	C 110
C092M1H152K		MYLAR 0.0015 50V	2	C 138,139
C092M1H155K		MYLAR 0.015 50V	1	C 127
C092M1H182K		MYLAR 0.0018 50V	2	C 128,162
C092M1H222K		MYLAR 0.0022 50V	1	C 137
C092M1H225K		MYLAR 0.022 50V	3	C 14, 23, 88
C092M1H333K		MYLAR 0.033 50V	2	C 98,152
C092M1H392K		MYLAR 0.0039 50V	3	C 100,101,102
C092M1H472K		MYLAR 0.0047 50V	6	C 86,125,131,148,163,166
C092M1H475K		MYLAR 0.047 50V	6	C 24, 25, 29, 87, 99,103
C092M1H562K		MYLAR 0.0056 50V	2	C 45,151
C092M1H685K		MYLAR 0.068 50V	1	C 167
C90-0478-05		ELECTRO 10 16V	1	C 165
C90-0504-05		ELECTRO 0.22 50V	1	C 26
C90-0825-05		ELECTRO 22 16V	3	C 75,147,154
C91-0117-05		CERAMIC 0.01 50V	10	C 5, 7, 10, 16, 28, 35, 73, 95,113,174
C91-0119-05		CERAMIC 0.047 25V	16	C 21, 38, 39, 40, 43, 44, 74,144
				22, 58, 64, 67,118,122,148,173
C91-0457-05		CERAMIC 0.022 50V	2	C 53, 54
C91-1008-05		CERAMIC 0.022 50V	18	C 19, 37, 42, 47, 57, 70, 81, 82, 83, 94
				114,115,116,117,119,120,121,170
DTA143XS	N	DIGITAL TR PNP	3	Q 22, 51, 54
DTC124ES		DIGITAL TR NPN	8	Q 39, 48, 49, 50, 56, 60, 61, 88
DTC144WS	N	DIGITAL TR NPN	4	Q 30, 31
	N			40, 52
E23-0512-05		TERMINAL 1P	1	
E40-0273-05		MINI CONNECTOR 2P	22	



# S-940S PARTS LIST

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
E40-0373-05		MINI CONNECTOR 3P	5	
E40-0473-05		MINI CONNECTOR 4P	8	
E40-0573-05		MINI CONNECTOR 5P	4	
E40-0673-05		MINI CONNECTOR 6P	3	
E40-0873-05		MINI CONNECTOR 8P	1	
G53-0511-04		PACKING LED	1	
HA1368		IC AF PA	1	IC 15
LT8001P		LED RED	2	D 49, 63
L30-0199-05		IFT 455 KHZ	1	L 10
L30-0503-05		IFT 455 KHZ	1	L 11
L34-0535-05		TUNING COIL 8.83MHZ	1	L 2
L34-0536-05		TUNING COIL	1	L 3
L40-1011-13		INDUCTOR 100 UH	1	L 6
L40-1021-03		INDUCTOR 1 MH	1	L 8
L40-3325-04		INDUCTOR 3.3 MH	1	L 9
L40-3391-13		INDUCTOR 3.3 UH	1	L 7
L40-4711-13		INDUCTOR 470 UH	3	L 1, 4, 5
L72-0342-05		CERAMIC FILTER CFV455F	1	CF 1
L79-0446-05		CERAMIC DISCRI CFV455S	1	L 12
MB3614		LINEAR IC QUADRUPLE	1	IC 9
MC911		DIODE	2	D 35, 60
MC921		DIODE	2	D 41, 84
			1	45
MTZ10JC		ZENER DIODE 10 V	1	D 37
MTZ12J		ZENER DIODE 12 V	1	D 52
MTZ12JC		ZENER DIODE 12 V	1	D 20
MTZ20JC		ZENER DIODE 20 V	1	D 54
MTZ3.6JB		ZENER DIODE 3.6V	1	D 47
MTZ5.6JA		ZENER DIODE 5.6V	1	D 51
MTZ9.1J		ZENER DIODE 9.1V	1	D 25
MV-203		VARISTOR	1	D 42
NJM2903D		LINEAR IC DUAL	1	IC 10
NJM4558S		LINEAR IC DUAL	2	IC 13, 14
N10-2030-41		HEX.NUT	5	
N30-3008-41		PAN HD SCREW M3X8, IC	3	
N30-3010-41		PAN HD SCREW M3X10	2	
N87-2606-41		TAPPING SCREW M2.6X6	3	
N87-3006-41		TAPPING SCREW M3X6	2	
RN14BK2E1002F		METAL FILM 10K OHM 1/4W	1	R 113
RN14BK2E1802F		METAL FILM 18K OHM 1/4W	2	R 111, 112
RN14BK2E9301F		METAL FILM 9.3KOHM 1/4W	1	R 100
RS14AB3A911J		METAL FILM 910 OHM 1W	1	R 52
R12-1428-05		TRIM.POT. 1K OHM	1	VR 14
R12-1429-05		TRIM.POT. 500 OHM	1	VR 10
R12-3443-05		TRIM.POT. 10K OHM	5	VR 1, 3, 8, 16, 19
R12-3450-05		TRIM.POT. 20K OHM	1	VR 4
R12-4413-05		TRIM.POT. 50K OHM	1	VR 2, 5, 6, 12, 13, 15, 18
R12-5420-05		TRIM.POT. 100KOHM	2	VR 7, 9
R12-7408-05		TRIM.POT. 500KOHM	2	VR 11, 17
SVO3YS		VARISTOR	1	D 57

[illegible]

# PARTS LIST TS-940S

**RIT ENCODER UNIT (X54-1690-01)**

[illegible]

**DIGITAL A UNIT (X54-1830-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC455L1H270J		CERAMIC 27P 50V	2	C 5, 6
CE04W1A221M		ELECTRO 220 10V	1	C 12
CE04W1H010M		ELECTRO 1 50V	1	C 3
CQ92M1H104K		MYLAR 0.1 50V	1	C 7
CS15E1A100M		TANTALUM 10 10V	1	C 10
C90-2001-05		ELECTRO 470 16V	1	C 1
C91-0119-05		CERAMIC 0.047 50V	6	C 8, 9, 14, 15, 16, 30
C91-0757-05		CERAMIC 0.001 50V	2	C 17, 18
C91-0761-05		CERAMIC 0.0022 50V	1	C 20
C91-0769-05		CERAMIC 0.01 50V	11	C 11, 13, 21, 22, 23, 24, 25, 26, 27, 28, 29
C91-1008-05		CERAMIC 0.022 50V	1	C 19
DTA114ES		DIGITAL TR PNP	1	Q 8
DTA124ES		DIGITAL TR PNP	2	Q 9, 10
E02-0122-05		IC SOCKET 24P	1	
E02-0123-05	N	IC SOCKET 28P	1	
E23-0437-05		TERMINAL (INSIDE	1	
E23-0512-05		TERMINAL 1P	1	
E40-0273-05		MINI CONNECTOR 2P	3	
E40-0373-05		MINI CONNECTOR 3P	4	
E40-0673-05		MINI CONNECTOR 6P	3	
E40-0773-05		MINI CONNECTOR 7P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
E40-0973-05		MINI CONNECTOR 9P	1	
E40-1073-05		MINI CONNECTOR 10P	2	
E40-1173-05		MINI CONNECTOR 11P	1	
E40-1273-05		PIN ASS'Y 12P	1	
HD74LS138P		TTL IC: 3 TO 8 DEMULTIPLEXER	1	IC 7
HD74LS245P		TTL IC 3STATES BUS X8	1	IC 10
HD74LS245WP		TTL IC 3STATES BUS X8	1	IC 10
J31-0502-04	*	COLLAR PC BOAD	6	
J31-0503-05		BEADS	8	
J32-0767-04		STUD & BOSS (STICK TYPE)	2	
J42-0428-05	*	BUSHING PC BOAD	6	
LH0080A		MICRO-PROCESSOR	1	IC 1
L78-0011-05	N	CERAMIC RESONATOR 2.45MHZ	1	X 1
MBM2764-30T2	N	N.MOS IC EP.ROM (8KX8)	1	IC 2
MB8416-20LP-GR4		C.MOS IC SR.RAM (2K X8)	1	IC 3
M5L8255AP-5		IC:PROGRAMABLE EXPANDER I/O	3	IC 4, 5, 6
M74LS32P		TTL IC 2-INPUT OR X4	2	IC 13, 14
N10-2026-46		HEX.NUT	2	
PST518A		SYSTEM RESET IC (VS=4.0-4.4V)	1	IC 21
R90-0188-05		CAP. BLOCK 0.01UF Y4	1	IB 9
R90-0241-05	N	CAP. BLOCK 0.01UF X6	1	IB 1
R90-0510-05		RESISTOR BLOCK 4.7KOHM X8	1	RB 2
R90-0533-05		RESISTOR BLOCK 10K OHM X10	1	RB 1

# FS-940S PARTS LIST

[illegible]

**DIGITAL B UNIT (X54-1840-00)**

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
CC45CH1H030C		CERAMIC	3P 50V	1	C 22
CC45CH1H100D		CERAMIC	10P 50V	2	C 43
CC45CH1H220J		CERAMIC	22P 50V	1	C 5, 26
CC45CH1H330J		CERAMIC	33P 50V	3	C 89
CC45RH1H030C		CERAMIC	3P 50V	1	C 10, 19, 30
CC45RH1H050C		CERAMIC	5P 50V	1	C 40
CC45SL1H121J		CERAMIC	120P 50V	1	C 92
CC45SL1H151J		CERAMIC	150P 50V	2	C 93
CC45SL1H331J		CERAMIC	330P 50V	2	C 74
CC45SL1H390J		CERAMIC	39P 50V	1	C 8, 27
CC45SL1H560J		CERAMIC	56P 50V	1	C 7, 28
CC45UJ1H050C		CERAMIC	5P 50V	3	C 76
CC45UJ1H090C		CERAMIC	9P 50V	1	C 52
CC45UJ1H220J		CERAMIC	22P 50V	1	C 17, 38, 44
CC45UJ1H330J		CERAMIC	33P 50V	1	C 23
CE04W1A101M		ELECTRO	100 10V	2	C 41
CE04W1A470M		ELECTRO	47 10V	2	C 20
CE04W1C330M		ELECTRO	33 16V	2	C 111, 113
C092M1H393K		MYLAR	0.039 50V	1	C 47, 72
C092M1H473K		MYLAR	0.047 50V	1	C 16, 57
C05-0044-05		TRIM. CAP	30P	3	C 35
C91-0117-05		CERAMIC	0.01 50V	10	C 14
C91-0119-05		CERAMIC	0.047 25V	3	TC 1, 2, 3
C91-0457-05		CERAMIC	0.022 50V	4	C 1, 2, 3, 4, 9, 13, 32, 34, 70, 80
C91-0667-05		CERAMIC	0.0047 50V	2	C 79, 101, 112
C91-0757-05		CERAMIC	0.001 50V	7	C 106
C91-1008-05		CERAMIC	0.022 50V	12	C 31, 55, 67, 69
				2	C 48, 77
				5	C 15, 36
					C 18, 21, 39, 42, 49
					C 102
					C 103, 104, 105, 107, 108, 109, 110
					C 6, 12, 29, 33, 56, 66, 71, 82, 83, 84
				4	C 85, 87
					C 57, 58, 60, 63
DT0114ES		DIGITAL TR	NPN	1	Q 105
DT0124ES		DIGITAL TR	NPN	2	Q 104, 107
DT0144WS		DIGITAL TR	NPN	2	Q 103, 106
E40-0273-05		MINI CONNECTOR	2P	1	
E40-0373-05		MINI CONNECTOR	3P	1	
E40-0473-05		MINI CONNECTOR	4P	5	
E40-0573-05		MINI CONNECTOR	5P	2	
E40-0873-05		MINI CONNECTOR	8P	1	
E40-0973-05		MINI CONNECTOR	9P	1	
E40-1073-05		MINI CONNECTOR	10P	1	
E40-1174-05		MINI CONNECTOR	11P L TYPE	1	
E40-1274-05		MINI CONNECTOR	12P L TYPE	1	
E40-1373-05		MINI CONNECTOR	13P	1	
E40-3007-05		MINI CONNECTOR	2P	1	
J31-0502-04	*	COLLAR	PC BOAD	5	
J62-0428-05	*	BUSHING	PC BOAD	5	



# PARTS LIST TS-940S

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
LC7800		IC:4 TO 1 DATA SELECTOR X4	3	IC 109,110,111
L30-0516-05		IFT	1	L 15
L32-0678-05	N	OSCILLATING COIL 45.5MHZ	1	L 6
L32-0679-05	N	OSCILLATING COIL 71.5MHZ	1	L 10
L33-0684-05	N	CHOKE COIL 33 UH	2	L 4, 8
L34-0536-05		TUNING COIL	1	L 14
L34-0683-05		TUNING COIL	2	L 19, 20
L40-1001-12		INDUCTOR 10 UH	1	L 21
L40-1011-03		INDUCTOR 100 UH	2	L 102,103
L40-1011-13		INDUCTOR 100 UH	1	L 101
L40-1211-03		INDUCTOR 120 UH	4	L 1, 2, 3, 18
L40-1511-03		INDUCTOR 150 UH	1	L 12
L40-1592-02		INDUCTOR 1.5 UH	1	L 11
L40-1811-03		INDUCTOR 180 UH	1	L 13
L40-2201-03		INDUCTOR 22 UH	1	L 9
L40-2215-25		INDUCTOR 10 UH	1	L 16
L40-2715-25		INDUCTOR 10 UH	1	L 17
L40-4701-03		INDUCTOR 47 UH	1	L 5
L40-5691-02		INDUCTOR 5.6 UH	1	L 7
L72-0350-05	N	CERAMIC FILTER 9285KHZ	1	CF 1
L72-0351-05	N	CERAMIC FILTER 8.83MHZ	1	CF 2
L77-1271-05	N	CRYSTAL 9MHZ	2	X 1, 2
MC74HC157N		IC:2 TO 1 DATA SELECTOR X4	1	IC 112
MN6147		PLL IC OR MN6147C	2	IC 1, 2
MN6147C		PLL IC	2	IC 1, 2
NV-203		VARIATOR	2	D 11, 12
MS4459L		IC: DIVIDER 1/20 OR 1/100	2	IC 3, 5
N87-2606-46		TAPPING SCREW M2.6X6	4	
N87-3006-46		TAPPING SCREW, FOOT	3	
N87-3012-46		TAPPING SCREW FINAL UNIT	5	
R90-0123-05		RESISTOR BLOCK 4.7KOHM X4	1	RB 101
R90-0584-05		CAP. BLGCK 100P X7	1	C 94
SN16913P		D.B.M IC	2	IC 4, 6
TC4011BP		C.MOS IC 2-INPUT NAND X4	8	IC 101,102,103,104,105,106,107,108
1SS133		DIODE	11	D 101,103,104,105,116,118,122,125,126,128,137
			26	102,105,106,107,108,109,110,111,112,113,114,117,119,120,121,123,124,127,129,130,131,132,133,134,135,136
1SV123		VOLTAGE VARIABLE	4	D 4, 5, 7, 8
1S1587		DIODE	4	D 1, 2, 3, 6
			2	9, 10
2SC2458(Y)		TR	7	Q 12, 13, 14, 15, 17,101,102
2SC2668(Y)		TR	4	Q 4, 5, 9, 10
2SC2787(L)		TR	4	Q 1, 6, 11, 16
2SC3113(B)		TR	4	Q 2, 3, 7, 8
3SK73(GR)		FET	1	Q 18

**DIGITAL C UNIT (X54-1850-00)**

[illegible]

# 'S-940S PARTS LIST

## AT UNIT (X57-1130-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH2H270J		CERAMIC 27P 500V	1	C 13
CE04W0J101M		ELECTRO 100 6.3V	2	C 206,208
CE04W1A101M		ELECTRO 100 10V	1	C 203
CE04W1C100M		ELECTRO 10 16V	4	C 108,111,112,224
CE04W1C101M		ELECTRO 100 16V	3	C 204,205,207
CE04W1C470M		ELECTRO 47 16V	1	C 116
CE04W1HR33M		ELECTRO 0.33 50V	1	C 217
CE04W1HR1M		ELECTRO 0.1 50V	1	C 220
CE04W1H010M		ELECTRO 1 50V	3	C 114,212,216
CE04W1H100M		ELECTRO 10 50V	2	C 1, 3
C092FM1H103K		MYLAR 0.01 50V	4	C 210,215,219,222
C092FM1H104K		MYLAR 0.1 50V	1	C 223
C092FM1H473K		MYLAR 0.047 50V	1	C 218
C092M1H333K		MYLAR 0.033 50V	1	C 214
C092M1H473K		MYLAR 0.047 50V	1	C 115
C02-0022-05		VARIABLE CAP. 300P 1-2KV	2	VC 1, 2
C05-0324-05		TRIMMER 60P	1	TC 101
C90-0840-05		ELECTRO 10 16V	1	C 117
C90-2015-05		ELECTRO 330 25V	1	C 209
C91-0456-05		CERAMIC 0.047 25V	2	C 12,107
			2	105,119
DTC114ES		DIGITAL TR NPN	1	Q 7
DTC124ES		DIGITAL TR NPN	12	Q 9, 10, 11, 12, 13,116,122,124,125,126,202,203
D40-0623-25		MECHANISM ASS'Y 1/200		
D40-0624-25		MECHANISM ASS'Y 1/300		
D40-0625-15		MECHANISM ASS'Y	1	
E04-0157-05	*	RF COAX. CABLE RECEPTACLE	3	
E40-0273-05	*	MINI CONNECTOR 2P	6	
E40-0373-05	*	MINI CONNECTOR 3P	3	
E40-0473-05	*	MINI CONNECTOR 4P	5	
E40-0573-05	*	MINI CONNECTOR 5P	3	
F20-0078-05		INSULATING PLATE	1	
F29-0014-05		INSULATING WASHER :TRANSISTOR	1	
HD10116		ECL IC DIFF' AMP X3	1	IC 101
HD10125		ECL IC LEVEL CONV'T X4	1	IC 103
HD10131		ECL IC D FLIP-FLOP X2	1	IC 102
J31-0502-04	*	COLLAR PC BOAD	8	
J42-0428-05	*	BUSHING PC BOAD	8	
LT8001P		LED RED	4	D 119,201,202,210
L34-2250-05	N	TUNING COIL A	1	L 1
L34-2251-05	N	TUNING COIL B	1	L 2
L34-2252-05	N	TUNING COIL C	1	L 3
L34-2253-05	N	TUNING COIL D	1	L 4
L39-0415-15		DETECTOR COIL A	1	L 102
L39-0416-05		DETECTOR COIL B	1	L 103
L40-1011-04		INDUCTOR 100 UH	1	L 5
L40-1011-12		INDUCTOR 100 UH	9	L 103,104,105,109,110,201,202,203,204
L40-1011-13		INDUCTOR 100 UH	1	L 106
L40-1011-14		INDUCTOR 100 UH	2	L 107,108

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
MC10116L		ECL IC DEFF' AMP X3	1	IC 101
MC10125L		ECL IC LEVEL CONV'T X4	1	IC 103
MC10131L		ECL IC D FLIP-FLOP X2	1	IC 102
MC140778CP		C.MOS IC 2INP' EX-NOR X4	1	IC 208
MTZ10J(A,B)		ZENER DIODE 10 V	5	D 11, 12, 13, 14,207
MTZ11JC		ZENER DIODE 11 V	1	D 211
MTZ16J(A,B)		ZENER DIODE 16 V	1	D 27
MTZ20J		ZENER DIODE 20 V	1	D 115
MTZ5.6JB		ZENER DIODE 5.6V	1	D 10
NE555P		TIMER IC	1	IC 106
NE556N	N	TIMER IC DUAL	1	IC 204
NJM2901		LINER IC QUADRUPLE	1	IC 104
NJM2904D		LINER IC DUAL	1	IC 105
N10-2030-46		NUT,TR M3	2	
RC05GF2H101J		RES. SOLID 100 OHM 1/2W	2	R 101,102
RC05GF2H821J		RES. SOLID 820 OHM 1/2W	1	R 9
RS14GB3D330J		METAL FILM 33 OHM 2W	3	R 221,222,223
R12-2410-05		TRIM.POT. 5K OHM	1	VR 102
R12-3434-05		TRIM.POT. 10K OHM	1	VR 101
R90-0515-05		RESISTOR BLOCK 10K OHM X4	1	RB 1
R90-0560-05		CAP.BLOCK 0.022 X5	1	IB 1
R90-0561-05		RESISTOR BLOCK 22K OHM X6	1	RB 2
R90-0570-05		DIODE BLOCK	2	IB 101,102
R90-0592-05	N	RESISTOR BLOCK 4.7KOHM X6	1	RB 3
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 1
S51-1424-05		RELAY DS-1 24V	7	RL 1, 2, 3, 4, 5, 6, 8
S51-2411-05		RELAY 321D024	1	RL 101
S51-2414-05		RELAY FBR244D012	1	RL 7
TC40018P		C.MOS IC	1	IC 207
TC40118P		C.MOS IC 2-INPUT NAND X4	1	IC 206
TC4027BP		C.MOS IC JK FLIP-FLOP X2	1	IC 205
T42-0303-05		MOTOR	2	M 1, 2
UPC78L08A		AVR IC 8 V	1	IC 202
UPC7805H		AVR IC 5 V	1	IC 201
UPC7812H		AVR IC 12V	1	IC 203
1N4448		DIODE	9	D 1, 2, 3, 4, 5, 6, 7, 8,112
1N60		DIODE	2	D 101,102
1SS133		DIODE	29	D 9, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26,107,108,109,110,111,113,114,116,117,118,203,204,205,206,208,209
1SS99		DIODE	4	D 103,104,105,106
1S1555		DIODE		D 1, 2, 3, 4, 5, 6, 7, 8,112
2SA1015(Y)		TR	7	Q 1, 2, 3, 4, 5, 6,201
2SA1048(Y)		TR	3	Q 101,102,123
2SA950(Y)		TR	4	Q 103,108,110,115
2SA966(Q)		TR	1	Q 118
2SA984K(E)		TR	1	Q 119
2SC2120(Y)		TR	4	Q 105,106,112,113
2SC2458(Y)		TR	8	Q 104,107,109,111,114,117,120,121

# PARTS LIST TS-940S

## KEYBOARD ASS'Y (S59-0433-15)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	2	
E40-0573-05		MINI CONNECTOR 5P	3	
E40-0673-05		MINI CONNECTOR 6P	1	
E40-0773-05		MINI CONNECTOR 7P	2	
E40-0873-05		MINI CONNECTOR 8P	1	
LN01201C		LED RED	3	D 39, 46, 48
LN01301C		LED GREEN	6	D 37, 40, 41, 42, 45, 47
LN01401C		LED UMBER	5	D 38, 43, 44, 49, 50

## LCD ASS'Y (W02-0368-05)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
B11-0427-08	N	REFLECTOR	1	
B11-0428-08	N	LIGHT GUIDING PLATE	1	
B30-0835-08	N	LAMP	2	
E29-0461-08	N	LCD CONNECTOR	2	
E31-3099-08	N	CONNECTOR WITH WIRE 2P	1	
E31-3100-08	N	INSIDE CONNECTING WIRE 10P	1	
FTD-7155	N	LCD	1	
HD44100	N	C.MOS IC LCD DRIVER	1	IC 2
HD44780	N	C.MOS IC LCD DRIVER	1	IC 1
J19-1416-08	N	LCD HOLDER	1	
RD73EB2822J		CHIP RESISTOR 2.2KOHM 1/8W	5	R 1, 2, 3, 4, 5
RD73EB28913J		CHIP RESISTOR 91K OHM 1/8W	1	R 6

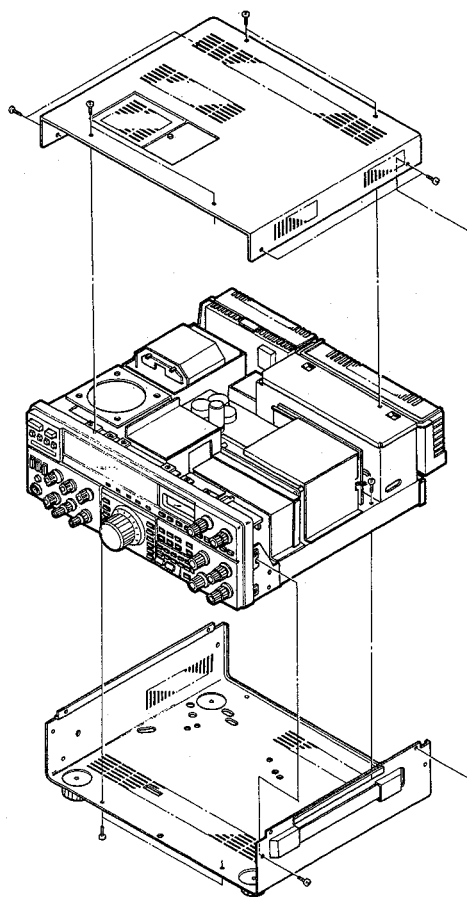
## MAIN ENCODER ASS'Y (W02-0328-10)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CE04W1A470M		ELECTRO 47 10V	1	C 1
E40-0474-05		MINI CONNECTOR 4P L TYPE	1	
LM358P		LINEAR IC DUAL	1	IC 1
LN66(S)		DIODE	2	D 1, 2
PN126S		PHOTO TRANSISTOR	2	Q 2, 3
R12-2411-05		TRIM.POT. 5K OHM	2	VR 1, 2
2SA1015(Y)		TR	1	Q 1
25D29		THERMISTOR 500 OHM	1	TH 1

# S-940S DISASSEMBLY

## Disassembly and assembly for upper and bottom case

- 1) When removing the top and bottom case take round head screws, eight from upper case and nine from bottom case, cautions on removing case from scratches slightly shift the case to rear side.
- 2) When assemble the case take back words process of disassembly with pay attention for pinched wire between case and chassis.



## Disassembly and cautions for rear panel

- 1) Take care not to damage terminals ANT and GND on the rear panel since they are soldered or screwed to the PC board.
- 2) When repairing the final section, remove the upper and lower cases, then the final heatsink and shield case for the Filter unit. (When repairing the Filter unit, remove the above parts, too.)

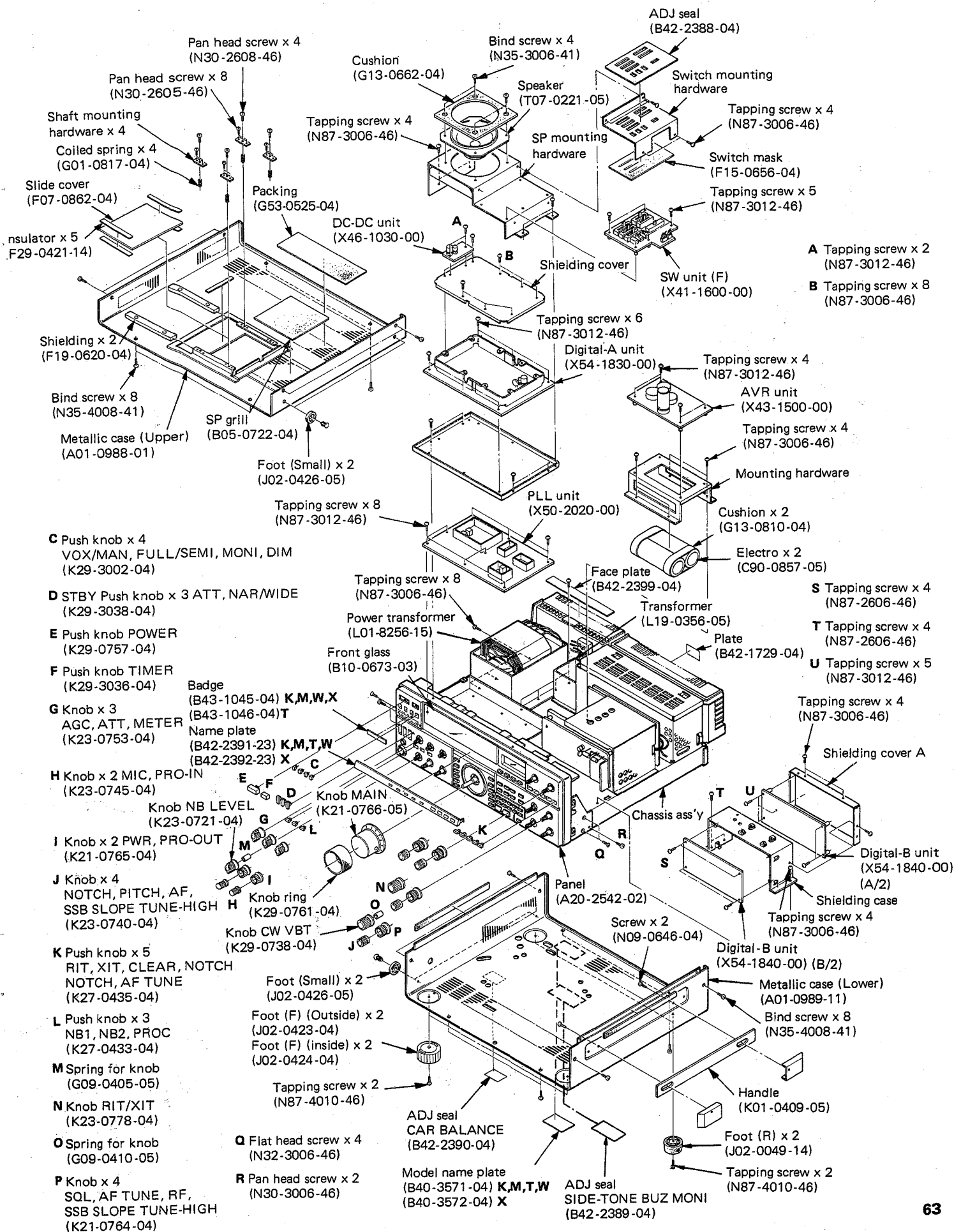
## Disassembly and cautions for internal mechanism

- 1) Cautions on replacement of transformer  
Tighten the hexagon socket head bolts to torque of 20kg-cm. Check the transformer for shock, looseness, and correspondence.
- 2) Removing mounting hardware for electric capacitor.  
The mounting hardware for electric capacitor can be removed by removing four screws.
- 3) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

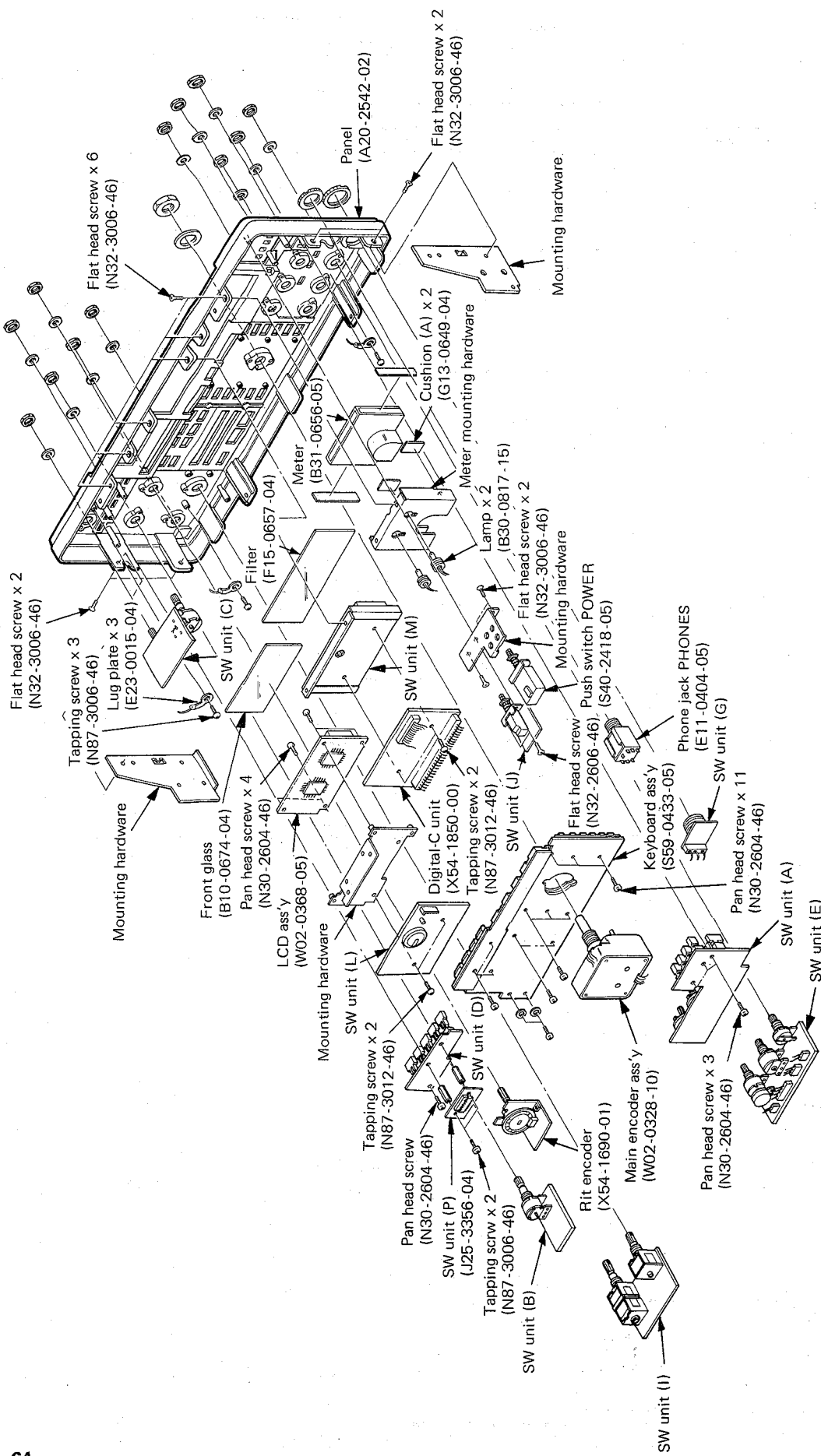
## Disassembly for front panel

- 1) To incline the front panel, remove two flat screws from the mounting hardware which securing the chassis and panel, and loosen two round screws. The panel at chassis side will incline more than 90°, and the parts at inside of the panel can be inspected and repaired easily.
- 2) Removing main knob  
If the dial ring fit to the rim of main knob is removed, the hexagon socket head bolt can be seen which is securing the main knob. The main knob can be removed by loosening this bolt.
- 3) When removing the KEY BOARD ASS'Y (MODE, FUNCTION, MEMORY, BAND KEY), remove the main encoder and eleven flat screws (M2.6 x 4)
- 4) When replacing the name plate on the display window for display and meter, push each end and two middle of the name plate from rear with a thin screw driver through the square hole on the panel.
- 5) When replacing the front glass, remove the name plate and two flat screws (M2 x 6)
- 6) When removing the display take from the mounting hardware, insert a thin screw driver, etc. into the mounting hardware at both sides. Remove the display tube with the screw driver from the projection of the mounting hardware for display tube.

# DISASSEMBLY TS-940S

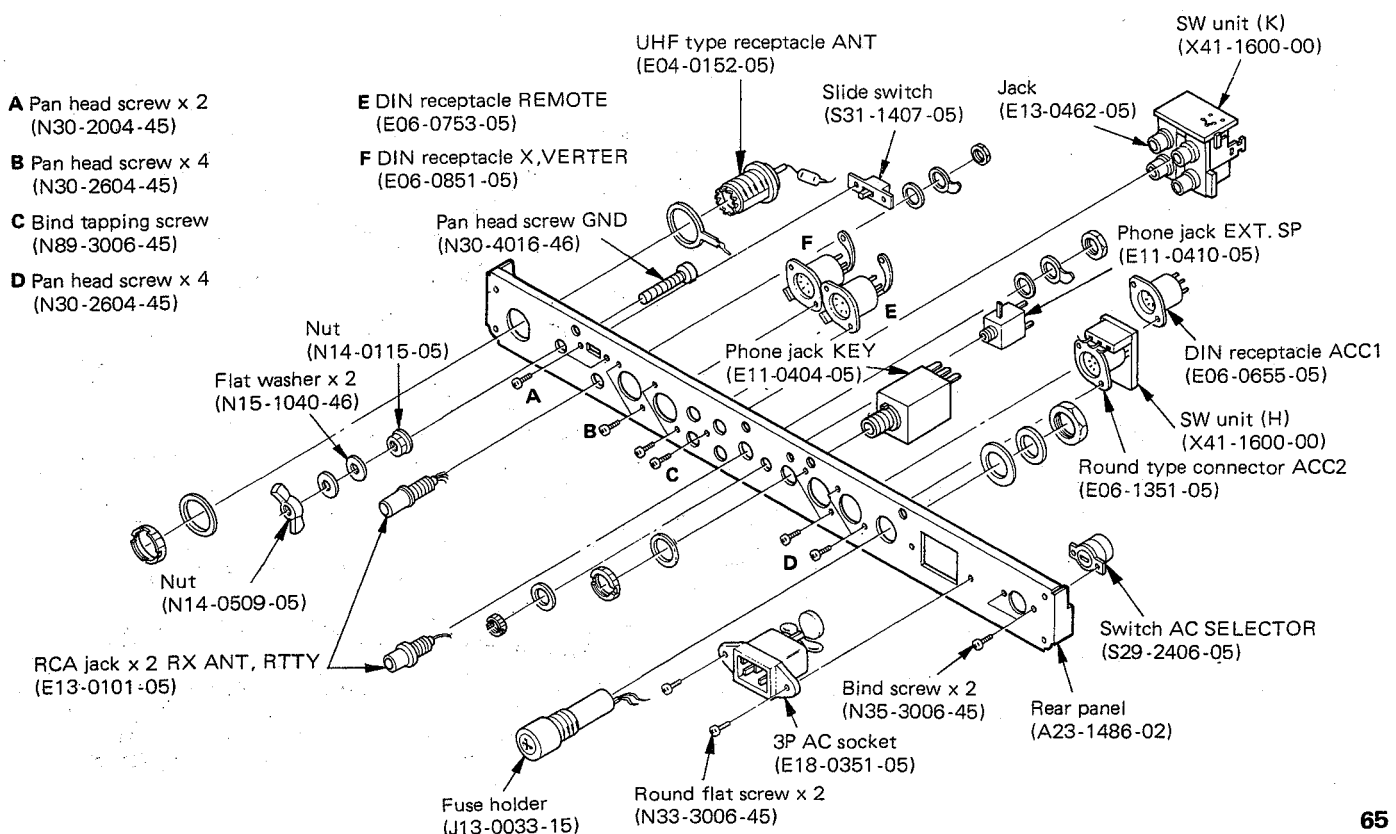
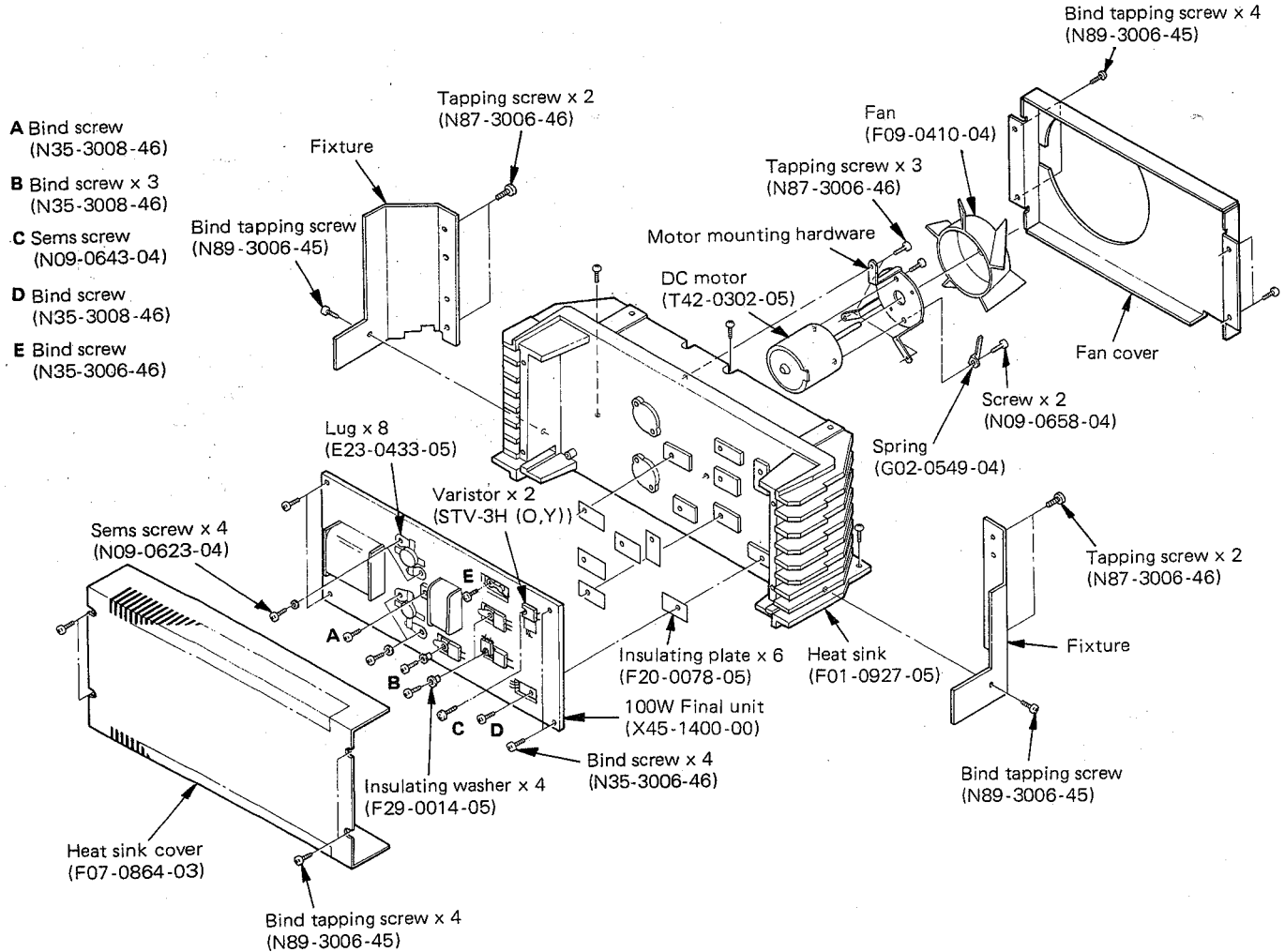


TS-940S DISASSEMBLY



SW unit (X41-1600-00)		VOX/MAN, FULL/SEMI, MONI, DIM, SEND/REC, AT, T, NAR/WIDE		E		NB LEVEL	
A	S4-10	(S40-2440-15)	Push switch	VR7	(R01-0407-05)	Pot.	PROC-IN/OUT
	S11	(S01-1432-05)	Rotary switch	VR8	(R19-3422-05)	Pot.	MIC
	S12	(S01-1431-05)	Rotary switch	G	J2	(E06-0858-05)	8P metal socket
	S13	(S01-1430-05)	Rotary switch	I	S2	(S29-1434-05)	Rotary switch
	S14-16	(S40-2434-05)	Push switch	S3	(S29-2410-05)	Rotary switch	CW VBT
	VR12	(R19-3413-05)	Pot.	J	S26	(S40-2453-05)	Rotary switch
B	VR10	(R19-3421-05)	Pot.	L	S1	(S50-1411-05)	Tact switch
C	VR11	(R24-9402-05)	Pot.	M	V1	(11-BT-05Z)	Display tube
D	S17-19	(S40-2439-15)	Push switch				SSB SLOPE TUNE-HIGH/LOW
	S20, 21	(S40-2438-15)	Push switch				TIMER

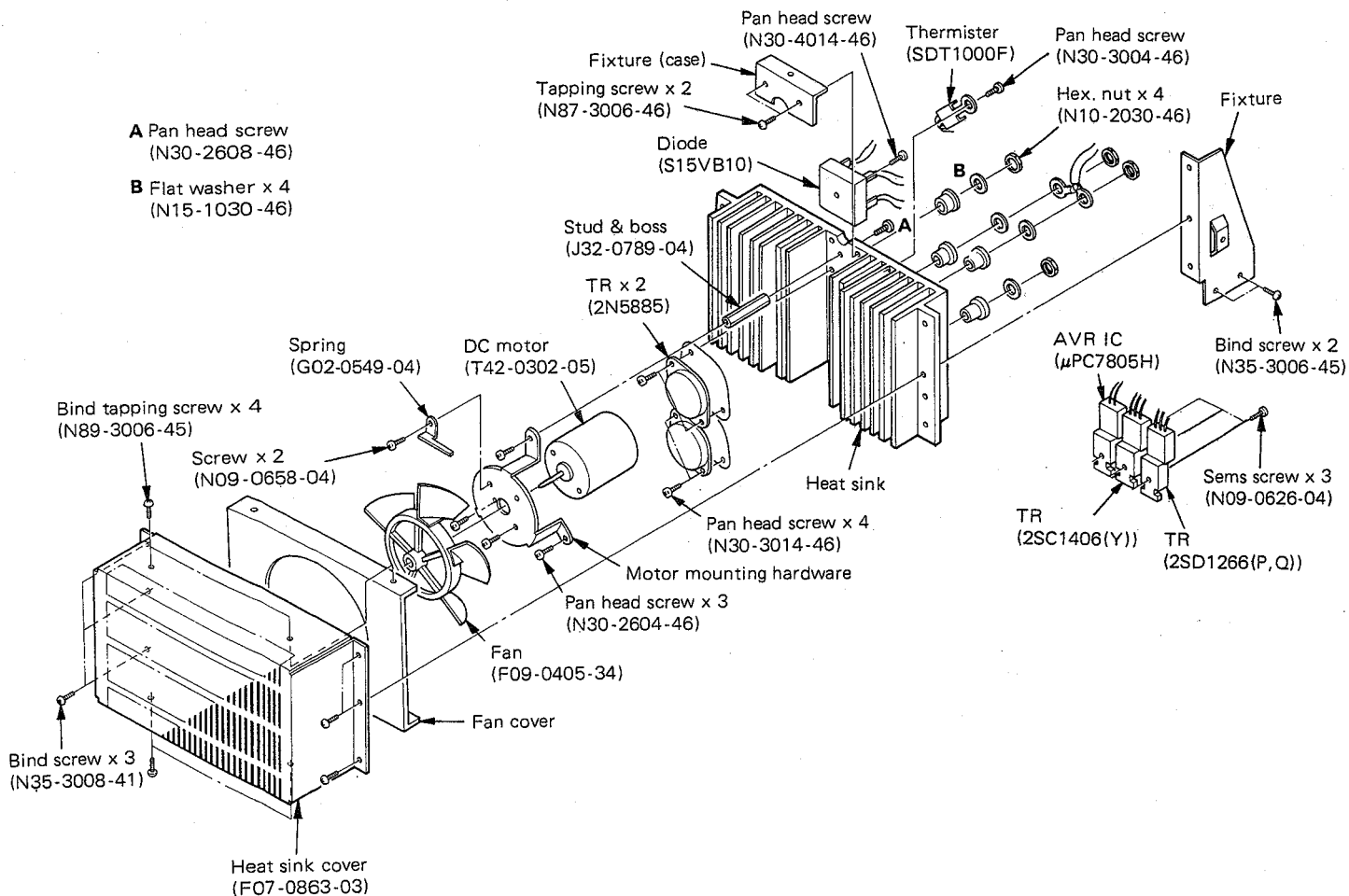
# DISASSEMBLY TS-940S



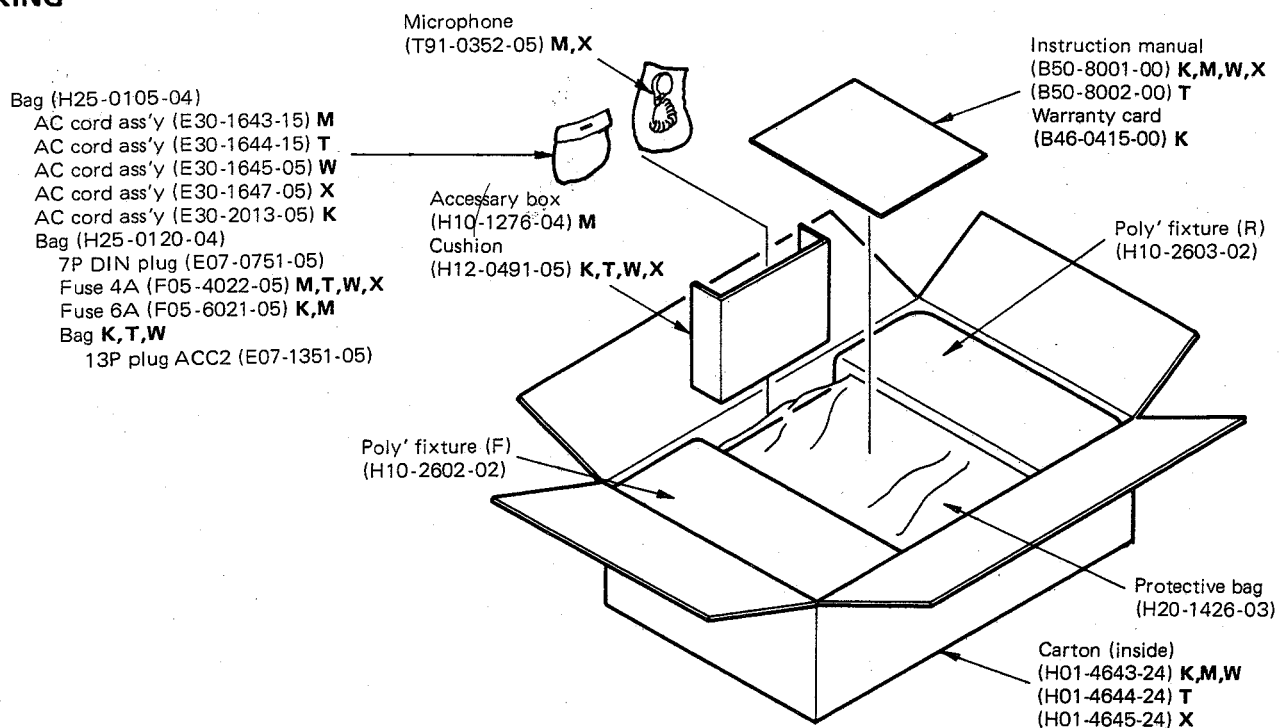
# TS-940S DISASSEMBLY/PACKING

**A** Pan head screw  
(N30-2608-46)

**B** Flat washer x 4  
(N15-1030-46)



## PACKING





## ADJUSTMENT

### REQUIRED TEST EQUIPMENT

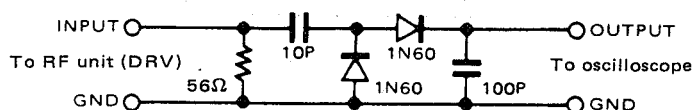
1. **DC Voltmeter (DC V.M)**
  - 1) Input resistance : More than  $1\text{M}\Omega$
  - 2) Voltage range : 1.5 to 1000 V AC/DC

**NOTE :** A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. **DC Ammeter**
  - 1) Current range : 100mA, 1.5A, 15A, High-precision ammeter may be used.
3. **RF VTVM (RF V.M)**
  - 1) Input impedance :  $1\text{M}\Omega$  and less than 3pF, min.
  - 2) Voltage range : 10mV to 300V
  - 3) Frequency range : 10kHz to 100MHz or greater
4. **AF Voltmeter (AF V.M)**
  - 1) Frequency range : 50Hz to 10kHz
  - 2) Input resistance :  $1\text{M}\Omega$  or greater
  - 3) Voltage range : 10mV to 30V
5. **AF Generator (AG)**
  - 1) Frequency range : 200Hz to 5kHz
  - 2) Output : 1 mV or less to 1 V, low distortion
6. **AF Dummy Load**
  - 1) Impedance :  $8\Omega$
  - 2) Dissipation : 3W or greater
7. **Oscilloscope (SCOPE)**

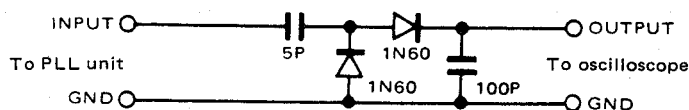
Requires high sensitivity, and external synchronization capability.
8. **Sweep Generator (SWEEP)**
  - 1) Center frequency : 50kHz to 90MHz
  - 2) Frequency deviation : Maximum  $\pm 35\text{MHz}$
  - 3) Output voltage : 0.1 V or greater
  - 4) Sweep rate : At least 0.5sec/cm
9. **Standard Signal Generator (SSG)**
  - 1) Frequency range : 50kHz to 50MHz
  - 2) Output :  $-20\text{dB}/0.1\mu\text{V}$  to  $120\text{dB}/1\text{V}$
  - 3) Output impedance :  $50\Omega$
  - 4) AM and FM modulation can be possible.

**NOTE :** Generator must be frequency stable.
10. **Frequency Counter (FREQ.C)**
  - 1) Minimum input voltage : 50mV
  - 2) Frequency range : 50MHz or greater
  - 3)
11. **Noise Generator**

Must generate ignition noise containing harmonics beyond 30MHz.
12. **RF Dummy Load**
  - 1) Impedance :  $150\Omega$  and  $20\Omega$
  - 2) Dissipation : 150W or greater
13. **Power Meter**
  - 1) Impedance :  $50\Omega$
  - 2) Dissipation : 150W continuous or greater
  - 3) Frequency limits : 60MHz or greater
14. **Spectrum Analyzer (SPE-ANA)**
  - 1) Frequency range : 100kHz to 110MHz or greater
  - 2) Bandwidth : 1 kHz to 3MHz
15. **Detector**
  - 1) For adjustment of TX BPF



2) For adjustment of PLL/VCO BPF



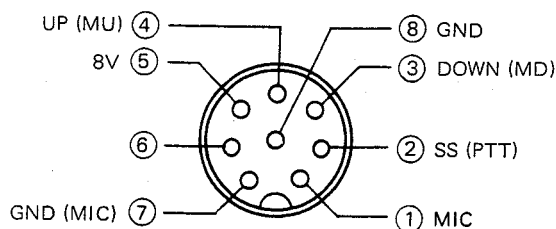
16. **Directional Coupler**

17. **Monitor Receiver**

R-1000 class

18. **Microphone**

MC-60S8 or MC-42S







**MIC terminals (view from front panel side)**

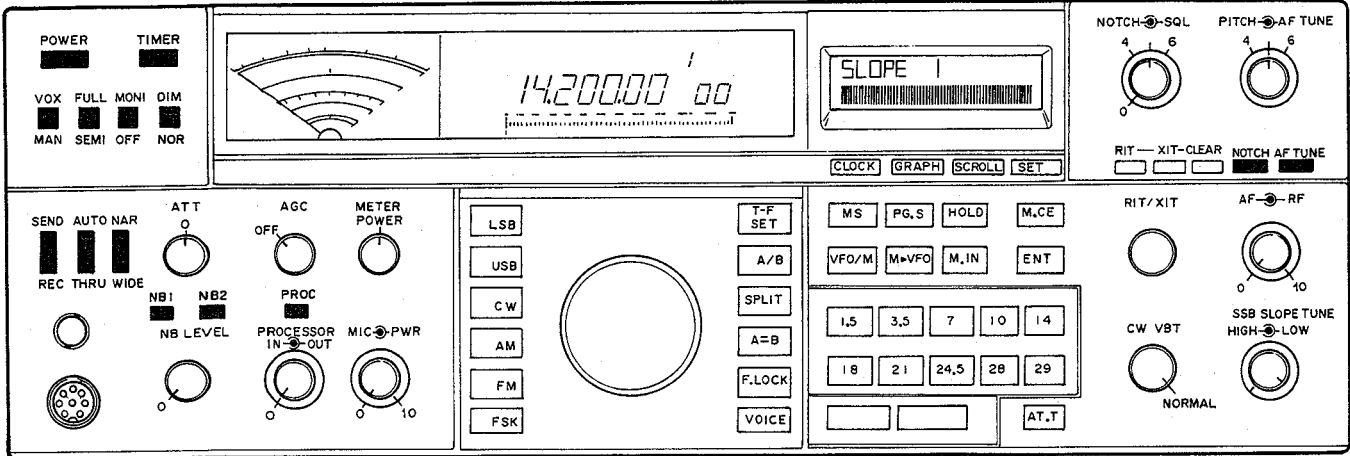
ADJUSTMENT

PREPARATION

Unless otherwise specified, set the controls as follows :

1. Power ON, holding A=B SW, keep  condition from  or  SW's which marked  .  
(other push SW's are nonlock type or tact SW.)

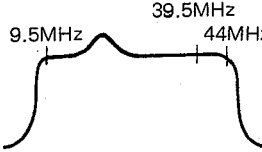
2. ATT ..... 0 NOTCH/SQ L ... CENTER/0  
AGC ..... OFF PITCH/AF TUNE ... CENTER  
METER ..... POWER AF/RF ..... 0/10  
NB LEVEL ..... 0 CW VBT ..... NORMAL  
PROCESSOR ..... 0 SSB SLOP TUNE  
MIC/PWR ..... 0/10 HIGH/LOW ... CW/CCW, MAX




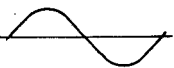
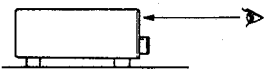
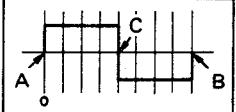
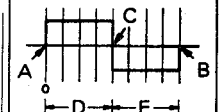
VOLTAGE ADJUSTMENT AND CONFIGURATION

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test-equipment	Unit	Terminal	Unit	Part	Method	
1. Voltage adjustment and confirmation	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	DC V.M	AVR	FB	AVR	VR1	ADJ to 28.5V	28.5V±0.5V
			IF	RV			Confirm	14.0—16.0V
				⑬ -2				
			RB	⑩ -5	CONT	VR1	ADJ to 2.1V	2.1V±0.01V
				RF	AGC	IF	VR5	ADJ to 3.2V
			IF	④ -2				
				W31			Confirm	About 14V
W22				About 12V				
	W21				About 11V			

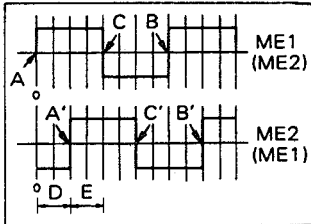
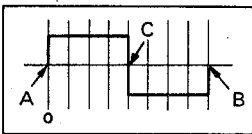
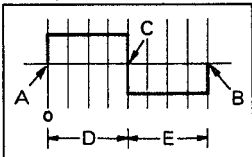
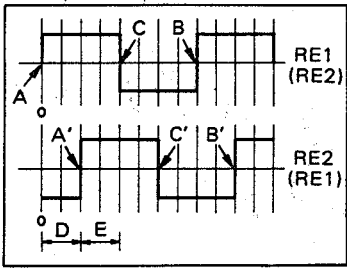
CONTROL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. PLL-BPF	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	SWEEP Detector SCOPE	PLL	TP4 TP5	PLL	L25— 27	ADJ as shown at right.	
2. PLL-1 100—110 MHz		RF V.M FREQ. C	PLL	TP1	PLL	L10	ADJ to 8V at 110MHz.	110MHz : 8V 100MHz : 3.5—4.5V

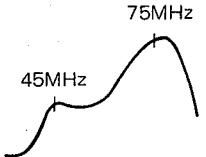
# ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
3. PLL-2 35.5–40.5 MHz	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	RF V.M FREQ. C	PLL	TP3	PLL	L5–6 L7	ADJ L5 and L6 for MAX. ADJ to 8V at 40.399.00MHz.	40.399.00MHz : 8V 35.499.00MHz : 3.5–4.5V
4. PLL-IF		RF V.M FREQ. C	PLL	TP5	PLL	L17, 18, 20–24	ADJ to MAX.	100–170mV
5. Standard oscillator adjustment and the marker check	1) CAL : ON BAND : 20.000.00MHz	SSG SCOPE	PLL	⑧-1	PLL	TC1	Receive the 10MHz and make the zero beat waveform as shown at right. (HET : 36.220.000 MHz)	Waveform on scope  NG  OK 
6. Adjustment of TX control voltage	1) Display : 14.600.00	DC V.M	IF	TV ⑬-1			Confirm	Under –0.5V.
	2) STBY : SEND						Confirm	14.0–16.0V
	3) STBY : REC after ADJ.			IF ⑥-1	CONT	VR3	ADJ to 3.2V	3.20V±0.01V
7. LCD Contrast			LCD		SW	VR13	Confirm LCD letters can see from as shown at right.	LCD control changes. 
8. VCO Adjustment	1) VCO1 Display : 9.499.99MHz	DC V.M	RF	VC1 ⑨-4	RF	L65	ADJ to 12V and confirm the VC1 voltage changes from about 2.5V to	12.00V±0.01V
	2) VCO2 Display : 19.499.99MHz					L68	4.0V with the display frequency from 30kHz to 9.5MHz and VC2 voltage changes also with the display from 20MHz to 29.5MHz.	12.00V±0.01V
	3) VCO3 Display : 30.000.00MHz			VC2 ⑨-2		L71		12.00V±0.01V
9. Main encoder	1) Remove the VFO knob and motor-drive the encoder at approx. 300rpm.	SCOPE	Digital B	Conne- tor ① ME 1–2	Main encod- er			Point C may be located anywhere. when a motor is not available, manually turn the VFO to check the duty ratio.
	2) ME1 duty ratio adjustment : Turn a motor CW and CCW					VR1		After adjusting with the VFO control tuned CW, check that intervals D and E are also identical when the VFO control is turned CCW.
	3) ME2 duty ratio adjustment : Turn a motor in the both direction.			Conne- tor ① ME 2–3		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	

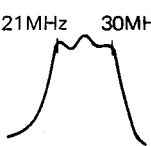
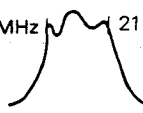

## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
9. Main encoder	4) ME1, ME2 phase difference alignment : Same as above. 	SCOPE	Digital B	Connector ① ME1, ME2	Main encoder	Phase adjustment screw	Adjust until intervals D and E are equal to each other (point A' on ME2 is located in the middle of points A and C on ME1.)	ME1 (ME2) : Within $90^\circ \pm 10\%$ (The difference between CW and CCW rotation must also be within this specification.) The phases of ME1 and ME2 may be replaced with each other, as indicated in the brackets.
10. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx. 300rpm.	SCOPE	Digital B	Connector ⑫ RE1-3				Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio.
	2) RE1 duty ratio adjustment : Turn a motor CW and CCW			Connector ⑫ RE2-2	RIT encoder	VR1		After adjusting with the RIT control tuned CW, check that intervals D and E are also identical when the RIT control is turned CCW.
	3) RE2 duty ratio adjustment : Turn a motor in the both direction					VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) RE1, RE2 phase difference alignment : Same as above.			Connector ⑫ RE1, RE2				The phases of RE1 and RE2 may be replaced with each other as indicated in the brackets.
11. CAR1 adjustment	1) MODE : USB	FREQ. C DC V.M	IF	CR1 ⑮ -2	CAR	TC1	ADJ to 453.50kHz	453.50kHz $\pm$ 50Hz
	2) STBY : SEND		CAR	TP1		L6	ADJ to 7.0V	7.00 $\pm$ 0.04V
	3) STBY : REC MODE : LSB		IF	CR1 ⑮ -2		TC2	ADJ to 456.50kHz	456.50kHz $\pm$ 50Hz

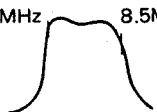
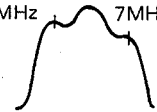
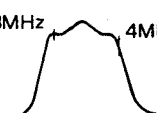
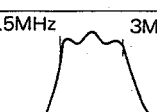
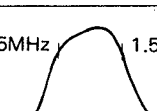
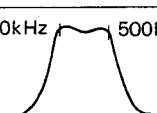
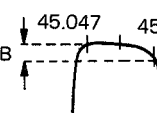
## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. CAR1 adjustment	4) STBY : SEND	FREQ. C DC V.M	IF	CR1 ⑱ -2	CAR		Confirm	Same frequency as REC.
	5) MODE : CW WIDE/NAR : WIDE STBY : REC						Confirm at REC & SEND	454.30kHz±50Hz
	6) WIDE/NAR : NAR						Confirm green LED light on.	455.00kHz±50Hz
	7) MODE : AM							
	8) MODE : FM							
	9) MODE : FSK WIDE/NAR : WIDE	FREQ. C	IF	CR1 ⑱ -2	CAR		Confirm	457.20kHz±50Hz
12. CAR2 Adjustment	1) MODE : CW					TC3	ADJ to 9.285.0MHz	9.285.00±50Hz (0.3Vrms)
						L10	ADJ to 7.0V	7.00V±0.04V
	2) STBY : SEND						Confirm	Same frequency as REC.
13. CAR3 Adjustment and confirmation	1) MODE : CW		CONT	CR3 ㉔ -4	IF	L20	ADJ to 100.0kHz	100.0kHz±20Hz
	2) MODE : USB : LSB : AM : FM : FSK						Confirm	USB : 98.5kHz±250Hz LSB : 101.5kHz±200Hz AM : 100.0kHz±100Hz FM : 100.0kHz±100Hz FSK : 101.5kHz±200Hz
14. CAR4 Adjustment	1) MODE : CW	FREQ. C	CONT	CR4 ㉔ -1	IF	L19	ADJ to 99.20kHz	99.20kHz±20Hz
	2) CW PITCH : MAX	RF V.M	IF	Q14 (E)		L18	ADJ to MAX.	About 0.3Vrms.
15. CAR AMP	1)	RF V.M	CAR	PLUG ㉔ -4	CAR	L19 L20	ADJ to MAX.	(REF. 100mV±50mV)
16. VCO BPF		SWEEP SCOPE Detector	RF	Q17-G Q21-E	RF	L74 -76	ADJ as shown at right.	

## RX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. 0.1—30MHz BPF	1) BAND : 20.0—30.0MHz FREQ : 29.500.0kHz RF ATT : 0dB STBY : REC  Disconnect RF unit, RIF connector, and connect this plug to detector.	SWEEP Detector SCOPE	Body	ANT	RF	L2, L31— 33,40, 44	Adjust as shown at right.	
	2) BAND : 14.0—20.0MHz FREQ : 18.000.0kHz		RF	RIF		L28— 30		
	3) BAND : 8.5—14.0MHz FREQ : 10.000.0kHz			L25— 27				

## ADJUSTMENT

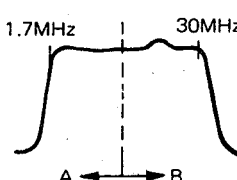
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. 0.1—30MHz BPF	4) BAND : 7.0—8.5MHz FREQ : 7.000.0kHz	SWEEP Detector SCOPE	Body RF	ANT RIF	RF	L22— 24	Adjust as shown at right.	7MHz 8.5MHz 
	5) BAND : 4.0—7.0MHz FREQ : 6.900.0kHz					L18— 21		4MHz 7MHz 
	6) BAND : 3.0—4.0MHz FREQ : 3.900.0kHz					L14— 16		3MHz 4MHz 
	7) BAND : 1.5—3.0MHz FREQ : 1.900.0kHz	SWEEP Detector SCOPE	Body RF	ANT RIF	RF	L11— 13	Adjust as shown at right.	1.5MHz 3MHz 
	8) BAND : 0.5—1.5MHz FREQ : 1.000.0kHz					L9, 10		0.5MHz 1.5MHz 
	9) BAND : 100—500kHz DISPLAY : 300.0kHz					L5— 7		100kHz 500kHz 
2. MCF	1) BAND : 14.250MHz MODE : CW	SWEEP	RF	TP1	RF	L44— 46	ADJ to MAX as shown at right. Center frequency 45.050MHz	45.047 45.053 0.5dB 
		SPE- ANA	IF	TP1	IF	L3—5		
3. RX IF AMP	1) MODE : CW BAND : 14.175MHz VR1-on RF unit : Center AF VR : As desire	SSG AF V.M SP SCOPE		EXT. SP	RF	VR2 L44— 46	VR2 ADJ to center and other L's ADJ to MAX AF output. Note : Repeat ADJ L7—10 and 23—25.	
	2) SSG : 15dB	DC V.M	CONT	TP1 (R153)	CONT	L2,3		
4. NOTCH	1) NOTCH VR : Center SSG : 0dB	SSG AF V.M					ADJ the AV VR to 800Hz/0.63V.	
	2) NOTCH SW : ON SSG : 40dB	SP SCOPE			IF	L16 VR2	Repeat ADJ for MIN AF output.	Dip point should be in between 11—1 o'clock position.
5. IF TRAP Coil	BAND : 1.400MHz SSG : 45.05MHz 80dB				RF	L2	Set the core all the way inside.	
						L40	ADJ for MIN AF output.	
6. S meter	BAND : 14.175MHz SSG : 0dB	SSG AF V.M SP SCOPE			IF	VR3	ADJ meter needle for mechanical $\phi$ point.	
					RF	VR1	Set the VR1 to CCW.	

## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
6. S meter	SSG : 8dB AGC : FAST				IF	VR1	ADJ to S1	S1 : 8dB +6dB -4dB
	SSG : 40dB					VR4	ADJ to S9	S9 : 40dB±6dB
							Repeat ADJ S1 and S9.	S9 + 60dB : 100dB±10dB
7. ATT Confirmation	BAND : 14.175MHz	SSG AF V.M SP			PAN-EL	ATT	ATT : SSG 10dB 50dB 20dB 60dB 30dB 70dB	10dB±3dB 20dB±6dB 30dB±9dB
8. FM IF	MODE : FM BAND : 14.175MHz SSG : 40dB f : 1kHz DEV : 5kHz				IF	L3-12, 35-38	ADJ to MAX. Repeat ADJ L3-5 and L7-10 for MAX S meter reading.	
					CONT	L11		
9. NB	1) FREQ : 14.175.0kHz MODE : USB SSG output : 14.175.0kHz	SSG DC V.M.	Rear panel	ANT	CONT	L2,3	MIN (SSG output : 20dB) Lower SSG output to the point where DC voltage falls slightly, and again reset to MIN.	
	2) MODE : USB NB LEVEL : CCW	Noise GEN. S meter	Rear panel	ANT			Adjust Noise GEN. level to read to S1.	
	3) NB 1 SW : ON Adjust NB LEVEL control to the point where N.B. action begins. (After checking, turn NB1 SW : OFF)				CONT	L2,3	MIN (If NB level has insufficient effect, adjust L8 core slightly CCW (out) from peak.	Noise disappears.
	4) NB 2 SW : ON (After checking, shut NB 2 SW OFF)						Confirm	The same effect as NB 1 is obtained.
	5) Raise Noise GEN. level to S9. NB1 SW : ON (After checking, turn NB1 SW OFF.)						If any noise remains adjust NB LEVEL to find the point where NB operates.	Noise disappears.
10. Buzzer	1) AF VR : MIN RF VR : MAX (CW) R290 (R205 side) connect to GND on CONT unit. (After ADJ disconnect.)				CONT	VR14	ADJ for 50mV/8Ω	50mV/8Ω±3dB
	2) AF VR : MAX RF VR : MIN (CCW)						Confirm	8.0mV/8Ω or less.

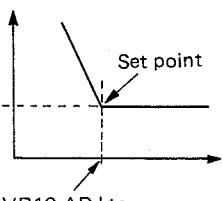
## ADJUSTMENT

### X ADJUSTMENT

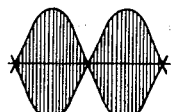

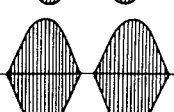
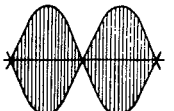
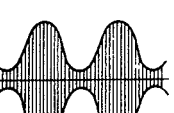
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Base current confirmation	1) Display : 14.250MHz MODE : USB STBY : SEND	DC V.M	AVR	FB			Connect DC V.M in FINAL DC cable and confirm the flow current.	1.1—1.5A
2. Drive	1) Display : 14.250MHz AG : 2.0mV, 1.5kHz Disconnect DRV connector and terminate with a 50Ω dummy load. (After ADJ, remove and reconnect DRV connector.)	AG SCOPE	RF	DRV	IF	L29, 31, 34—36, 41, 42, 44—46	ADJ to MAX. Note : While adjusting each coil, be keep output less than 2Vp-p by MIC GAIN or CAR VR control. 2) Repeat ADJ L46, 50, 51 and 52.	Greater than 2.3V p-p
					RF	L50—52		
	2) MODE : CW				IF	L40		
3. TX BPF 1.7—30MHz	1) RF ATT : 0dB FREQ : 14.175MHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load (After ADJ, re-connected DRV)	SWEEP SCOPE Detector	RF	R49	RF	VR3 L50—57, 60	ADJ to center. L50, 51, 52 ADJ to MAX. L53, 55, 57 ADJ for 1.7MHz side (A). L54, 56, 60, ADJ for 30MHz side (B). ADJ in upon order, so that wave form shown at right is obtained. (ADJ sweep band A and B separately.)	
4. Final bias	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN Desolder L7 lead and connect ammeter in its place, minus to L7 side. STBY : SEND (After adjustment, resolder L7 lead.)	DC am meter	FI-NAL	L7	FI-NAL	VR2	50mA Note : Stabilization requires approximately 20 seconds.	50mA±10mA
	2) FINAL unit VR1 : MIN Disconnect relay connector in FINAL unit, 28V line and connect ammeter in its place. STBY : SEND (Disconnect ammeter and reconnect this connector after ADJ.)					VR1	Read the meter when VR1 is at MIN. Then ADJ VR1 so that the current is increased by 1.3A.	1.3A±0.2A
5. TX IF AMP	1) FREQ : 14.175MHz MODE : USB AG : 1500Hz, 2mV METER : ALC STBY : SEND	RF V.M AG 8Ω Dummy load	Rear panel	ANT	IF	L40—42, 44—46	ADJ for MAX ALC meter reading. Repeat ADJ.	



## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
6. VC, IC METER and current limiter	1) METER : IC STBY : SEND		Meter		CONT	VR10	Set for mechanism start point.	IC meter Meter fluctuation 
	2) ANT : Connect dummy load METER : VC CONT VR2 : MAX MODE : FSK STBY : SEND PROCESSOR OUT : Set to 10A IC meter reading. (After ADJ, STBY : REC)	DC V.M	AVR	FB	AVR	VR1	ADJ to 28.5V	28.5V±0.5V
	3) METER : IC (After ADJ, STBY : REC)				CONT	VR11	ADJ to 28.5V	28.5V±1V
	4) MODE : CW CAR LEVEL : 10 (After ADJ, STBY : REC)					VR7	ADJ to 10A	10A±1A
			AVR	FB		VR6	Disconnect the FB terminal and connect the current meter between the FB lead and the FB terminal. ADJ to 14A.	14A±1A
7. Power	1) BAND : 14.175MHz MODE : CW CAR LEVEL : 10 METER : POWER STBY : SEND (After ADJ, STBY : REC)	Power meter	Rear panel	ANT	CONT	VR2	ADJ to 110W	
						VR17	ADJ meter reading to 110W.	110W±10W
8. Power (Low)	1) PWR VR : MIN CCW STBY : SEND (After ADJ, STBY : REC) (PWR VR : MAX CW)				CONT	VR19	ADJ to 5W	
9. AM Power	MODE : AM METER : POWER STBY : SEND (After ADJ, STBY : REC)				SW	CAR VR	AM power is adjustable with CAR VR.	
10. Protection and SWR	1) ANT : OPEN METER : Power				CONT	VR5	ADJ to 10W	10W±2.5W
	2) ANT : 150Ω Dummy load BAND : 3.750MHz METER : SWR	DC V.M 150Ω Dummy load	CONT	IC9- (12)		VR12	ADJ to 0.5V	0.5V±0.01V
	3) ANT : OPEN					VR18	ADJ to "3".	SWR : 3
	4) ANT : 50Ω Dummy load	Power meter					Confirm	SWR : ∞
							Confirm	SWR less than 1.2

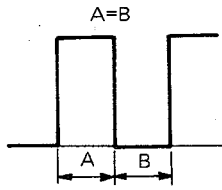
## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. SSB mode Frequency response	1) BAND : 14.175MHz MODE : USB AG output : 2 tone, 7mV 300Hz, 2700Hz STBY : SEND MIC VR : 50W output	Power meter SCOPE AG	Rear panel	ANT (Directional coupler) MIC	DG-B (CAR)	TC1	ADJ as shown at right. (Equal 300Hz, 2.700Hz amplitude within 5W.)	OK 
	2) MODE : LSB					TC2		NG 
	3) MODE : USB, LSB AG : 1500Hz, 5mV STBY : SEND						Calibrate scope.	NG 
	4) MODE : USB, LSB AG : 2600Hz, 5mV STBY : SEND						Confirm	Within 6dB (from 1500Hz)
	5) MODE : USB, LSB AG : 400Hz, 5mV STBY : SEND							
	6) Check carrier suppression after this ADJ.				IF	TC1 VR6		-50dB or less.
12. FSK	1) MODE : FSK COMP OUT : MIN AG : 2 tone 0.3V 1000Hz, 3400Hz STBY : SEND	AG	IF	AFS (24) -3	DG-B (CAR)	TC2	Turn comp VR CW until get enough signal to measure. ADJ TC2 and TC3 as shown at right.	OK 
		SCOPE		ANT (Directional coupler)		TC3		NG 
13. CAR suppression	1) FREQ : 14.175.0kHz MODE : USB ↔ LSB MIC CONTROL : MIN STBY : SEND	SCOPE (SPE-ANA)	Rear panel	ANT (through Directional coupler)	IF	TC1 VR6	MIN (Adjust alternately.) Adjust for no difference between USB and LSB.	
	2) MODE : CW CAR CONTROL : MAX STBY : SEND						Calibrate Oscilloscope (SPE-ANA)	
	3) MODE : USB ↔ LSB STBY : SEND						Check If less than -50dB, repeat adjustment 1).	-50dB or less.
14. FM Deviation	1) MODE : FM BAND : 29.25MHz MIC : 1kHz, 50mV FM MIC GAIN : MAX	AG Linear detector			CONT	VR16	1. Linear detector SET ex.) MS-57A/MS-61A HPF : OFF LPF : 20kHz 4101 FILTER : 25kHz/15kHz De-emphasis : OFF 2. ADJ to ±4.5kHz	DEV ±3kHz with less than 5mV MIC input. DEV ±4.0-6.0kHz with less than 50mV MIC input.

# ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remark
		Test equipment	Unit	Terminal	Unit	Part	Method	
15. ALC Meter	1) MODE : USB METER SW : ALC MIC VR : MAX AG : 1.5kHz, 5mV STBY : SEND	AG AF V.M Dummy load	S-meter		CONT	VR8	ADJ to the mechanical zero point.	
	2) ALC Meter zero ADJ				SW	MIC GAIN	ADJ for ALC meter zero point.	
	3) AG : 6dB up (After ADJ, STBY : REC)				CONT	VR9	ADJ for ALC zero MAX.	
	4) MODE : FM BAND : 29.25MHz (After ADJ, STBY : REC)				IF	VR9	ADJ for ALC zero MAX.	
16. Speech Processor	1) BAND : 14.250MHz MODE : USB METER : COMP MIC VR : MIN PRO : ON PROCESSOR : 9 o'clock AG (MIC) : 1.5kHz, 1mV STBY : SEND	AG AF V.M Dummy load	Panel Rear panel	MIC ANT	IF	L29, 31— 34, 36,41, 42, 44—46	ADJ for MAX comp meter reading.	
	2)					VR10	ADJ for MIN comp meter reading.	
	3) AG (MIC) : 20dB up (10mV)				Panel	Processor IN	ADJ for S1, S-meter reading.	
	4) AG (MIC) : 10dB up (32mV)				IF	VR7	ADJ for S1 + 20dB comp meter reading. Repeat ADJ 2), 3).	
	5) METER : ALC (After ADJ, STBY : REC)						Confirm the meter reading is increase.	
					IF	L33	ADJ for MAX ALC meter reading.	
17. Monitor Level	1) AGC : ON MONI : ON AF VR : Set to 0.63V/8Ω point with CAL marker signal. AG (MIC) : 1kHz, 10mV MIC VR : Within ALC zero. STBY : SEND	AF V.M SCOPE	Panel Rear-panel	MIC ANT	IF	L43	ADJ for MAX ALC meter reading.	0.63V/8Ω±3dB
	2) MIC terminate with 50kΩ MIC VR : MIN (After ADJ, STBY : REC, MONI : OFF)				CONT	VR13	ADJ to 0.63V/8Ω	
							Don't move AF VR and confirm the hum and noise.	Less than 1.5mV/8Ω
18. MIX Balance	1) BAND : 21,100.0kHz MODE : AM MIC VR : MIN STBY : SEND	Power meter Monitor receiver (SPE-ANA)	Rear panel	ANT	IF	VR8	21.555MHz : MIN (S meter and AF output.)	
	2) MODE : CW					VR10	29,930MHz : MIN (S meter and AF output.)	
	STBY : SEND				RF	VR3	23.950MHz : MIN (S meter and AF output.)	

## ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks					
		Test equipment	Unit	Terminal	Unit	Part	Method						
19. Side tone	1) MODE : CW AF VR : AF output 0.63V/ 8Ω with CAL marker signal.  MONI : ON KEY JACK : KEY IN	SCOPE FREQ. C			CONT	VR15	0.2V/8Ω 800Hz	0.2V/8Ω ± 6dB 800Hz±100Hz					
	2) PITCH CONTROL : MIN ↔ MAX						Confirm	800Hz±300Hz or more.					
20. AT-940 Auto antenna tuner (If in- stalled.)	1) BAND : 1,500.00MHz TC1 : Preset to center Disconnect the ③ on AT-B unit, the ⑭ on AT-A unit and jumper between TRQ and TV at the ④ on AT-B unit. CAR VR : MAX, METER : SWR, STBY : SEND Turn VFO frequency (up) until SWR becomes "3" (After ADJ, STBY : REC) STBY : SEND	Oscillo- scope	AT	JP124	AT-A	VR101	ADJ as shown at right.						
	2) Turn VFO frequency (down) until SWR becomes "1.15" (After ADJ, STBY : REC)					VR102	ADJ VR102 until ANT TUN indicator just goes off.						
	3) BAND : 18,000.00MHz STBY : SEND (After ADJ, STBY : REC Re- connect the ③ on AT-B and remove jumper between TRQ and TV on connector ④.)	20Ω & 150Ω Dummy load				TC1	ADJ for motor stops and SWR reads MIN.						
	4) Check at the each center frequency of the HAM BAND								Confirm	SWR 1.2 or less.			

### Microprocessor operation check

Item	Condition	Operation check
1. Reset	1) POWER SW : ON ↔ OFF Then, pressing A=B SW, power SW on.  Push S1 on LCD unit	Display : VFO A 14.000.00 USB Sub display : "TRIO-KENWOOD"
2. RIT/XIT	1) Turn RIT, XIT encoder knob UP ↔ DOWN	Display frequency in- crease or decrease smooth.
	2) Push RIT SW (ON) once	Display RIT and tone sounds.
	3) STBY : SEND (After check, STBY : REC)	Same frequency as RIT off.
	4) Push RIT SW (off) once.	Display RIT light off and tone sounds.
	5) Push XIT SW (on) once.	Display XIT on and tone sounds.

Item	Condition	Operation check
2. RIT/XIT	6) Push XIT SW (off) once.	Display XIT light off and tone sounds.
	7) Push clear SW	RIT frequency display changes to "00".
3. Function	1) Push SPLIT SW once.	SPLIT light on (orange).
	2) Push T-F SET SW once.	Display : VFO B "14.000.00" While pressing.
	3) Push A/B SW once.	Display : "VFO B" "14.000.00" and tone sounds.
	4) STBY : SEND	Display : "VFO A"
	5) STBY : REC	Display : "VFO B"

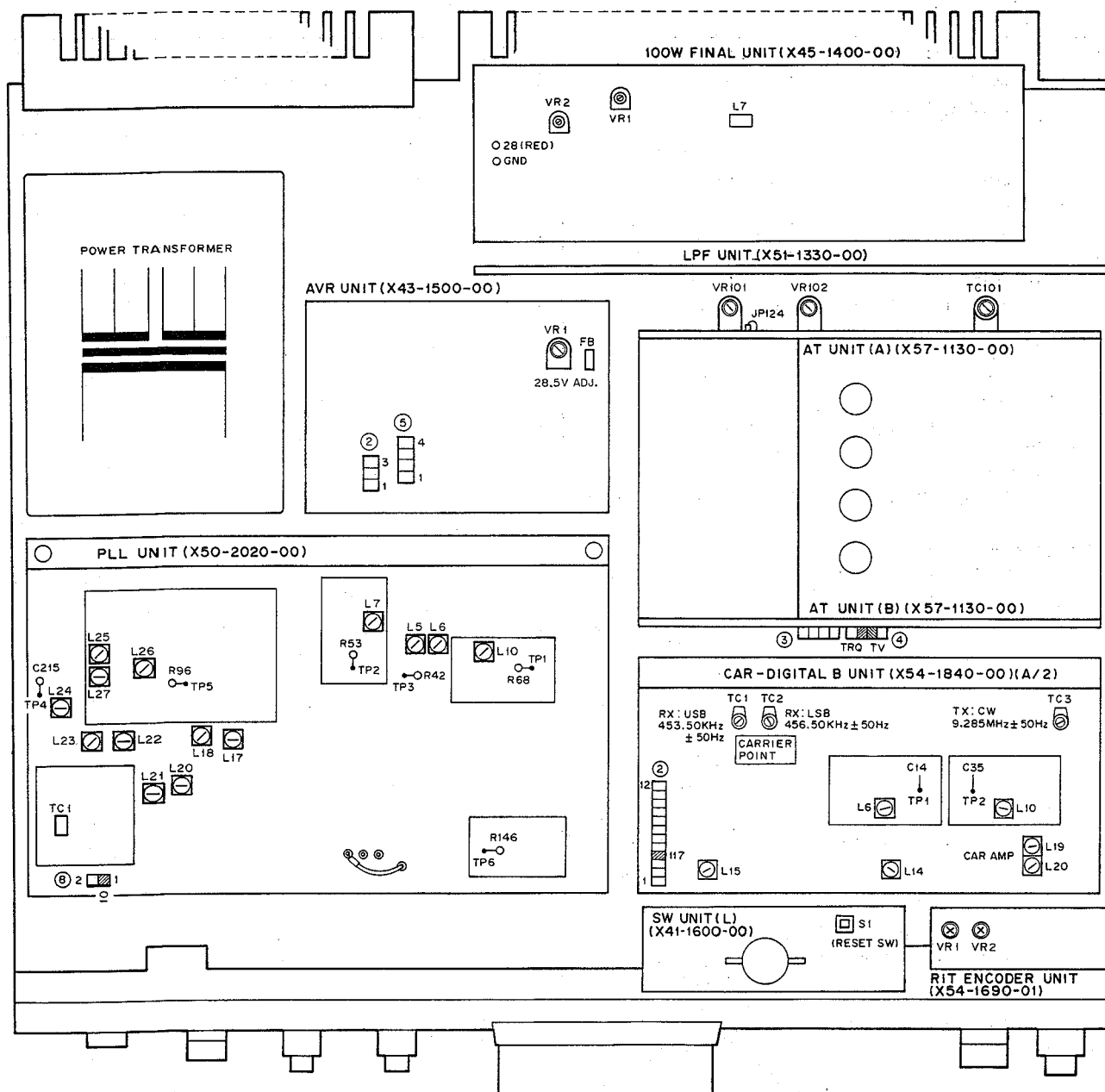
## ADJUSTMENT

Item	Condition	Operation check
3. Function	6) Push A=B SW once.	Tone sounds.
	7) Push A/B SW once.	Display : "VFO A" "14.000.00" and tone sounds.
	8) Push F.LOCK SW (on) once.	Display : F.LOCK and tone sounds.
	9) Turn VFO knob.	Confirm the display frequency doesn't change.
	10) Push 1.5 SW.	Doesn't change any.
	11) Push F.LOCK SW (off) once.	Display F.LOCK light off and tone sounds.
	12) Push ENT → 1 → 2 → 3 → 4 → 5 → 6 → 7 SW's	Display : " 1 2 3 4 5 6 7 "
	13) Push VOICE SW. (Install the option voice synthesizer unit VS-1.)	Sounds verifies displaced frequency.
4. Memory	14) Push SPLIT SW once.	Display : SPLIT, orange light off.
	1) Push 29 SW	CH      FREQ      MODE
	2) Push both SW M.IN and 1 once then enter the MEMO as on right chart.	1      29.000.00      CW
		2      28.000.00      CW
		3      27.000.00      USB
		4      26.000.00      USB
		5      25.000.00      LSB
		6      24.000.00      LSB
		7      23.000.00      AM
		8      22.000.00      AM
		9      21.000.00      FM
		10      21.005.00      FSK
	3) Push PG.S SW (on) once.	Orange light on and scans from "21.000.00" to "21.005.00" on "FM" mode.
	4) Push HOLD SW (on) once and turn main VFO knob.	Red LED light on and tone sounds. Scans manually by VFO knobs.
	5) Push HOLD SW (off) once.	Red LED light off and tone sounds. then, starts auto-scan.
	6) Push PG.S SW (off) once.	Orange LED light off and tone sounds.
	7) Push MS SW (on) once.	Green LED and MEM light on and tone sounds. Scans MEMO from MEMO1 to MEMO0, (skips memorized channels.)
	8) Push MS SW (off) once.	Green LED light off and tone sounds.
	9) Push both M.CE and 1 switches.	Tone sounds.

Item	Condition	Operation check
4. Memory	10) Push VFO/M → 1 SW	Display : " . . . " "MEMO 1"
	11) Push 4 SW	Display : "26.000.00" "MEMO 4"
	12) Push M ► VFO SW	Display : "26.000.00" "VFO A"
5. Timer	1) Push "S1" on LCD unit.	Display : "TRIO-KENWOOD"
	2) Push "CLOCK" SW once.	Display : 0 : 00 off 0 : 00 on 0 : 00
	3) Push "SET" SW once.	0 ? 00 off 0 : 00 on 0 : 00
	4) Push "MODE" SW once.	0 : 00 off 0 ? 00 on 0 : 00
	5) Push "MINUTE" SW once.	0 : 00 off 0 ? 00 on 0 : 00
	6) Push "MODE" SW once.	0 : 00 off 0 : 01 on 0 ? 00
	7) Push "MINUTE" SW twice.	0 : 00 off 0 : 01 on 0 : 02
	8) Push "MODE" SW once.	0 : 00 off 0 : 01 on 0 : 02
	9) Push "TIMER" SW (on).	
	10) Push " SCROLL" SW once.	Display : V-B 14.000.00 US 1M1 . . .
	11) Push "SCROLL" SW once and confirm the display changes as shown at right. Ten times round one cycle.	V-B 14.000.00 US 1M2 28.000.00 CW
		V-B 14.000.00 US 1M3 27.000.00 US
		V-B 14.000.00 US 1M4 26.000.00 US
		V-B 14.000.00 US 1M5 25.000.00 LS
		V-B 14.000.00 US 1M6 24.000.00 LS
		V-B 14.000.00 US 1M7 23.000.00 AM
		V-B 14.000.00 US 1M8 22.000.00 AM
		V-B 14.000.00 US 1M9 21.000.00 FM
		V-B 14.000.00 US 1M0 21.005.00 FS
		V-B 14.000.00 US V-A 14.000.00 US
	12) Switch to "MEMORY BAND 2"	V-B 14.000.00 US 2M1 . . .
	13) Switch to "MEMORY BAND 3"	V-B 14.000.00 US 3M1 . . .
	14) Switch to "MENORY BAND 4"	V-B 14.000.00 US 4M1 . . .

## S-940S ADJUSTMENT

**TOP VIEW**

**PLL UNIT (X50-2020-00)**

L5-7 : PLL-2 adj. (35.5-40.5MHz)  
L10 : PLL-1 adj. (100-110MHz)  
L17,18,20-24 : PLL IF adj.  
L25-27 : PLL BPF adj. (9.5-44MHz)  
TC-1 : STD freq' adj (20MHz)

**AT UNIT (A) (X57-1130-00)**

VR101 : Waveform ratio (A=B)  
VR102 : ANT TUNE indicator goes off

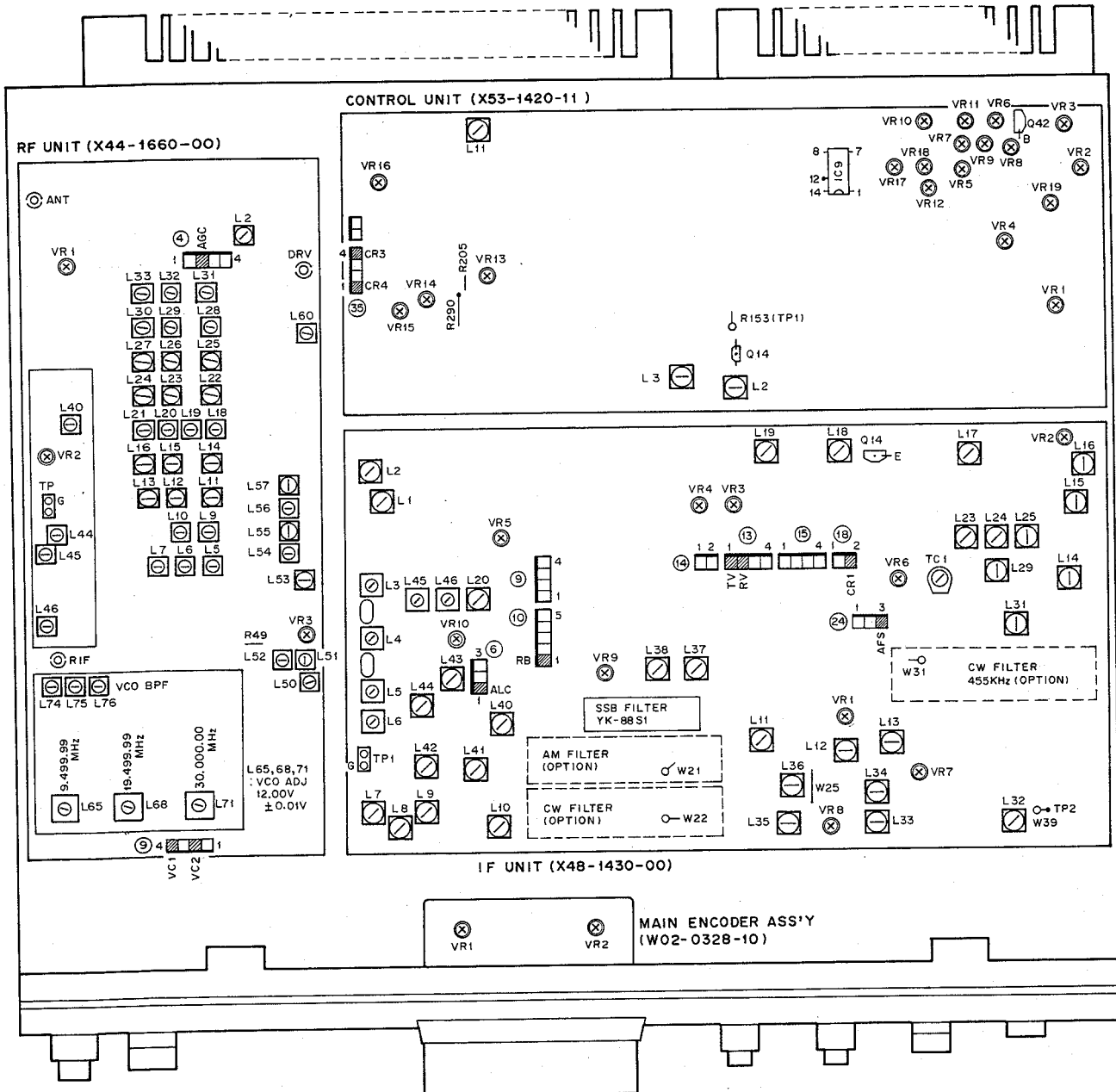
TC101 : Motor stop and SWR reads MIN

**100W FINAL UNIT (X45-1400-00)**

VR1 : 130mA +100mA, -50mA (100W Final bias)  
VR2 : 50mA  $\pm$  10mA (10W Final bias)

# ADJUSTMENT TS-940S

## BOTTOM VIEW



### RF UNIT (X44-1660-00)

- L2,40 : IF TRAP adj. (BAND 1.400MHz, SSG : 45.05MHz 80dB)
- L5-7 : BPF 100-500kHz (Freq. : 300.0kHz)
- L9,10 : BPF 0.5-1.5MHz (Freq. : 1,000.0kHz)
- L11-13 : BPF 1.5-3.0MHz (Freq. : 1,900.0kHz)
- L14-16 : BPF 3.0-4.0MHz (Freq. : 3,900.0kHz)
- L18-21 : BPF 4.0-7.0MHz (Freq. : 6,900.0kHz)
- L22-24 : BPF 7.0-8.5MHz (Freq. : 7,000.0kHz)
- L25-27 : BPF 8.5-14MHz (Freq. : 10,000.0kHz)
- L28-30 : BPF 14.0-20.0MHz (Freq. : 18,000.0kHz)
- L31-33 : BPF 20.0-31.0MHz (Freq. : 29,500.0kHz)
- L44-46 : MCF (Center freq. : 45.050MHz)
- L50-52 : DRIVE adj.
- L53,55,57 : TX BPF 1.7MHz Side (A)
- L54,56,60 : TX BPF 30MHz Side (B)
- L65 : VCO1 adj. (9,499.99MHz)
- L68 : VCO2 adj. (19,499.99MHz)
- L71 : VCO3 adj. (30,000.00MHz)
- L74-76 : VCO BPF
- VR1 : RF AGC adj. (AF output 0.2dB down)
- VR2 : MIXER BALANCE adj.
- VR3 : MIXER BALANCE adj. (CW 23.950MHz)

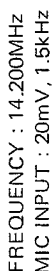
### IF UNIT (X48-1430-00)

- L1,2 : IF OUT adj. (8.83MHz)
- L3-6 : MCF adj. (RF unit : L44-46)
- L7-15,17,23-25 : SSB IF GAIN adj.
- L16 : NOTCH adj.
- L18,19 : CAR4 adj. (99.20kHz±20Hz)
- L20 : CAR3 adj. (100.0kHz±20Hz)
- L29,31,34-36,40-42,44-46 : DRIVE adj.
- L32 : COMP LEVEL adj.
- L33 : ALC LEVEL adj.
- L43 : MONI LEVEL adj.
- L37,38 : FM IF GAIN adj.
- VR1 : RX S-meter Sens. S-1
- VR2 : NOTCH adj. (VR2 and L16)
- VR3 : RX S-meter  $\phi$  adj.
- VR4 : RX S-meter Sens. S-9
- VR5 : AGC adj. 3.2V
- VR6 : CARRIER SUPPRESSION adj. (VR6 and TC1)
- VR7 : COM LEVEL adj. (VR7 and L32)
- VR8 : MIXER BALANCE adj. 21.555MHz (AM 21.1MHz)
- VR9 : ALC LEVEL adj. (FM 29.25MHz)
- VR10 : MIXER BALANCE adj. (CW 29.930MHz)

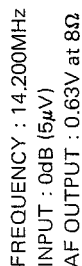
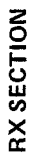
### CONTROL UNIT (X53-1420-11)

- L2,3 : SSB IF GAIN (MIN. adj.)
- L11 : FM IF GAIN
- VR1 : RB adj. 2.1V
- VR2 : MAX POWER adj. (110W)
- VR3 : ALC adj. 3.2V
- VR5 : SWR protection adj. (100W)
- VR6 : Current protection adj. 14A
- VR7 : IC meter adj. 10A
- VR8 : ALC  $\phi$  adj.
- VR9 : ALC meter adj.
- VR10 : IC  $\phi$  adj.
- VR11 : VC meter adj. 28.5V
- VR12 : SWR standard adj. 0.5V
- VR13 : MONITOR LEVEL adj.
- VR14 : BUZZER LEVEL adj.
- VR15 : Side tone level
- VR16 : DEV.
- VR17 : Power meter adj.
- VR18 : SWR meter adj.
- VR19 : MIN. power adj. (5W)

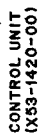
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- 1) Adjust at S-1 meter reading by PROC-IN VR.
- 2) ( ) : When adjust MIC input voltage so that voltage of  $50\Omega$  Dummy Load becomes  $3V_{pp}$ .



- 1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting.  
Set the AF gain control for 0.63V/8 $\Omega$  (50mW) audio output at 0dB signal generator input at 14,200MHz.
- 2) To measure signal generator output connect a 0.01 $\mu$ F 500WV capacitor between the signal generator and the check point.





# TERMINAL FUNCTION TS-940S

Terminal			Terminal Function	
No.	Name	I/O		
SWITCH UNIT (L)				
①	1	VBY	I	VS-1 Busy signal
	2	VSR	O	VS-1 voice synthesizer start signal
	3	PS4	O	VS-1 voice synthesizer data
	4	PS0	O	
	5	PS1	O	
	6	PS2	O	
	7	PS3	O	+ 5V for VS-1
	8	5C1	O	
②	1	21T	I	+ 21V
	2	GND		GND
③	1	SB0	I	Display data for LCD
	2	SB1	I	
	3	SB2	I	
	4	SB3	I	
	5	MRQ	I	Clock for data
	6	GND		GND
④	1	GND		GND
	2	RS	O	Resister, select signal
	3	RW	O	Write/Read signal
	4	LE	O	Latch signal
	5	DB4	O	Data
	6	DB5	O	
	7	DB6	O	
	8	DB7	O	
	9	5L		+ 5V for LCD ass'y
	10	LG	O	LCD Intensity control bias, -3V approx.
⑤	1	GND		GND
	2	HS	O	LCD data accept signal message
	3	5C	O	+ 5V for Digital B unit
	4	8B	O	+ 8V for Digital B unit
⑥	1	8C	I	+ 8V
	2	GND		GND
	3	TMY	O	Timer output, Timer SW ON, Timer SW OFF : H
⑦	1	TMY	I	Timer SW OFF : L
	2	TMR	I	Timer SW ON : L
⑧	1	ATV	I	AT unit TX data
	2	TNQ	I	AT unit STBY signal
⑨	1	5K	I	+ 5V
	2	SET	I	SET KEY
	3	GRP	I	GRAPH KEY
	4	SCR	I	SCROLL KEY
	5	CLK	I	CLOCK KEY
	6	GND		GND
④⑨	1	GND		GND
	2	LG		Sub display contrast
	3	VE		
SWITCH UNIT (II)				
⑩	1	VB0	O	Bit 0
	2	VB1	O	Bit 1
	3	VB2	O	Bit 2
	4	VB3	O	Bit 3
	5	VB4	O	Bit 4
⑪	1	VB		VBT
	2	SH	I	SLOPE HIGH cut
	3	SL	I	SLOPE LOW cut
SWITCH UNIT (A)				
⑫	1	TM	O	Meter SW common
	2	SSB	I	SSB mode : 15V
	3	CWB	I	CW mode : 15V
	4	MA	I	AM, SSB mode : 15V
⑬	1	15B	I	+ 15V
	2	MS	O	Power supply for monitor, MONI SW ON : 15V
	3	FBK	O	CW mode FULL/SEMI SW, FULL : 15V
	4	VS2	O	CW mode VOX SW ON : 15V
	5	VS1	O	AM, SSB mode VOX SW ON : 15V
	6	SS	O	STBY SW, MIC PTT ON : 0V

Terminal			Terminal Function	
No.	Name	I/O		
⑭	1	SPL	I	SPLIT LED light on
	2	DIM	O	DIM SW output, OFF : 0V
	3	TX	I	STBY control by $\mu$ -com, SEND : H, REC : L
⑮	1	ATT1	O	ATT relay drive
	2	ATT2	O	
⑯	1	NAR	I	NAR LED control for Mode
	2	15V		+15V
	3	CWB	I	CW mode : 15V
	4	SS	I	MIC PTT ON : 0V
	5	WIDE	O	NAR SW OFF : 5V (approx.)
⑰	1	ATI	O	AUTO/THRU SW AUTO : 15V
	2	TUN	I	AT tuning : H
⑱	1	15B	I	+15V
	2	NB1	O	NB1 SW
	3	NB2	O	NB2 SW ON : H
⑲	1	PRM	I	COMP meter
	2	MVG		Mic line GND
	3	PRS	O	SSB mode PROC SW ON : 15V
	4	MV2	O	MIC GAIN/PROC-IN VR
⑳	1	GND		GND
	2	PIL	I	PROC-IN VR OUT
	3	MVG		MIC line GND
	4	MVG		
	5	MG	I	MIC GAIN VR OUT
	6	NBL	O	NB LEVEL VR
	7	15	O	+15V for SW unit (E)
㉑	1	ALM	I	ALC meter
	2	PWR	I	Power meter
	3	SWR	I	SWR meter
	4	ICM	I	IC meter
	5	VCM	I	VC meter
	6	AG0	O	AGC OFF : 15V
	7	NAF	I	SSB, FSK, CW mode : 15V
	8	AGS	O	AGC SLOW : 15V, Normally : -12V
		NAI	O	NAR SW ON : H
		NAR	I	NAR LED control for MODE
		TUN	O	TUNE LED light ON
		SPL	O	SPLIT LED light ON
		PL	O	Power supply for meter lamp
		G		GND for meter lamp
<b>SWITCH UNIT (D)</b>				
㉒	1	CWB	I	CW mode : 15V
	2	GND		GND
	3	15V	I	+15V
㉓	1	AP5	O	CW mode AF TUNE ON : 15V
	2	AP0	O	CW mode AF TUNE OFF : 15V
	3	NTH	O	NOTCH SW ON : 15V
	4	15V	O	+15V for SW unit (C)
㉔	1	GND		GND
	2	RCL	O	CLEAR SW
	3	XIT	O	XIT SW
	4	RIT	O	RIT SW
<b>SWITCH UNIT (K)</b>				
㉕	1	IO2	I	IF OUT2 (4th IF 100kHz)
	2	GND		GND
	3	LO1	I	PHONE OUT
	4	GND		GND
	5	GND		GND
	6	IO1	I	IF OUT 1 (8.83MHz)
	7	GND		GND
	8	LN1	I	PHONE IN

# 'S-940S TERMINAL FUNCTION

Terminal			Terminal Function	
No.	Name	I/O		
SWITCH UNIT (F)				
(26)	1	V15	I	+ 15V
	2	VXC	I	ANTI VOX VR
	3	VXG		GND
	4	ANV	O	ANTI VOX VR
	5	MVG		Mic line GND
	6	FMC	O	FM MIC GAIN VR
	7	DLY	I	VOX DELAY VR
	8	VXG		GND
	9	VX2	O	VOX GAIN VR
(27)	1	MVG		Mic line GND
	2	MV1	I	FM MIC GAIN VR, VOX GAIN VR
(28)	1	CV2	O	} CAR VR
	2	CV1	I	
(29)	1	MB0	O	Memory bank SW data, 2, 3 : H
	2	MB1	O	Memory bank SW data, 1, 3 : H
	3	100	O	VFO : 100kHz SCALE DATA : L
	4	10	O	VFO : 10kHz DIGIT DATA : L
(30)	1	GND		GND
	2	MKS	O	MARKER SW ON : L
(48)	1	GND		GND
	2	LG		} Sub display contrast
	3	VE		
SWITCH UNIT (J)				
(31)	1	TMY	O	TIMER SW OFF : L
	2	GND		GND
	3	TMR	O	TIMER SW ON : L
SWITCH UNIT (G)				
(32)	1	8V	I	+ 8V
	2	MD	O	MIC DOWN SW
	3	MU	O	MIC UP SW
	4	SS	O	PTT SW
	5	MIC	O	MIC COM
	6	GND		MIC GND
	7	GND		GND
SWITCH UNIT (H)				
(33)	1	GND		GND
	2	REC	O	RX AFSK signal
	3	MSL	O	MIC select
	4	SS	I	STBY control
	5	MIN	I	TX AFSK signal
	6	GND		GND
	7	GND		GND
SWITCH UNIT (M)				
(34)	1	XIT	I	XIT display data
	2	RIT	I	RIT display data
	3	FG	I	Heater for display tube
	4	DP	I	Dot display data
	5	a	I	Segment data a
	6	SC	I	Scale display data
(35)	1	MEMO	I	MEMO display data
	2	P9	I	Analog digit data
	3	G5	I	Grid data No. 5
	4	P10	I	Analog digit data
	5	G6	I	Grid data No. 6
	6	P4	I	} Analog digit data
	7	P3	I	
	8	G7	I	Grid data No. 7
	9	P2	I	} Analog digit data
	10	P1	I	
	11	G8	I	Grid data No. 8
	12	G9	I	Grid data No. 9

Terminal			Terminal Function	
No.	Name	I/O		
③⑥	1	—	I	— (minus) display data
	2	b	I	Segment data b
	3	G1	I	Grid data No. 1
	4	P5	I	Analog digit data
	5	G2	I	Grid data No. 2
	6	P6	I	} Analog digit data
	7	P7	I	
	8	G3	I	Grid data No. 3
	9	P8	I	Analog digit data
	10	G4	I	Grid data No. 4
	11	c	I	Segment data c
	12	g	I	Segment data g
③⑦	1	e	I	Segment data e
	2	d	I	Segment data d
	3	G10	I	Grid data No. 10
	4	VFO B	I	VFO B display data
	5	VFO A	I	VFO A display data
	6	FH	I	Heater for display tube
	7	LOCK	I	LOCK display data
	8	f	I	Segment data f
SWITCH UNIT (E)				
③⑧	1	PC0	O	TRQ-H : H, Normally : —12V
	2	—12	I	—12V
	3	TRQ	I	AT STBY signal (For power control OFF)
③⑨	1	PRL	O	PROC-OUT VR (DC)
	2	SFT	I	PROC-OUT VR, SSB, FSK mode TX : 15V
	3	MVG		Mic line GND
	4	MV1	I	MIC GAIN VR
④⑩	1	NBL	O	NB LEVEL VR
	2	GND		GND
	3	MVG		Mic line GND
	4	PIL	O	PROC-IN VR
	5	15	I	+ 15V
	6	MVG		Mic line GND
	7	MG	O	MIC GAIN VR
	8	MVG		Mic line GND
	9	MV1	O	MIC GAIN VR
④⑪	1	GND		GND
	2	PC	O	Power control VR
④⑫	1	PC1	O	} Power control VR
	2	PC2	I	
SWITCH UNIT (C)				
④⑬	1	AP1	I	} CW PITCH VR
	2	AP2	O	
	3	AP3	O	} AF TUNE VR
	4	AP4	I	
	5	CWP	O	CW PITCH VR
	6	NTH	O	NOTCH VR
	7	AP0	O	CW mode AF TUNE OFF : 15V
	8	AP5	O	CW mode AF TUNE ON : 15V
④⑭	1	AP5	I	CW mode AF TUNE ON : 15V
	2	AP0	I	CW mode AF TUNE OFF : 15V
	3	15V	I	+ 15V
	4	GND		GND
	5	NTH	I	NOTCH SW ON : 15V
④⑮	1	NTL	O	NOTCH LED light on, NOTCH SW ON : H
	2	FMG	I	FM mode : 0V
④⑯	1	SQ2	O	} SQL VR
	2	SQ1	I	
SWITCH UNIT (B)				
④⑰	1	GND		GND
	2	AVG		AF line GND
	3	AV2	O	AF GAIN VR
	4	AVG		AF line GND
	5	AV1	I	AF GAIN VR
	6	RFG	O	RF GAIN VR

# TERMINAL FUNCTION TS-940S

Terminal				Terminal Function
No.	Name	I/O		
AVR UNIT (X43-1500-00)				
①	1	AC2	I	} AC LINE for AVR (21T)
	2	AC1	I	
②	1	PE	I	Q103 Emitter
	2	PC	O	Q103 Collector
	3	PB	O	Q103 Base
③	1	28C	O	+ 28V to POWER SW
	2	28B	I	+ 28V from POWER SW
④	1	21T	O	+ 21V for Control unit
	2	GND		GND
⑤	1	21T	O	+ 21V for Control unit
	2	28C	O	+ 28V for Control unit
	3	21B	I	+ 21V for AVR unit
	4	GND		GND
⑥	1	10E	I	Q104 Emitter
	2	10C	O	Q104 Collector
	3	10B	O	Q104 Base
⑦	1	10V	I	+ 10V for IC101 : 5V AVR IC
	2	GND		GND
	3	5V	O	+ 5V AVR output
⑧	1	10L	O	+ 10V for LCD ass'y
	2	GND		GND
⑨	1	5CO	O	+ 5V for Control unit
	2	5IF	O	+ 5V for IF unit
	3	GND		GND
	4	5KE	O	+ 5V for key board ass'y
	5	GND		GND
	6	5DA	O	+ 5V for Digital A unit
	7	GND		GND
	8	10DA	O	+ 10V for Digital A unit
⑩	1	ICA	O	Detect terminal for VC, IC meter
	2	ICB	O	Detect terminal for IC meter
⑪	1	FAN	O	Fan motor control output
	2	GND		GND
⑫	1	40V	I	40V DC inline
	2	BS1	O	Q102 Base
	3	BS2	O	Q101 Base
⑬	1	THM	I	Thermister TH101 output
	2	18	O	+ 18V for thermister TH101
		28A	I	Q101, 102 output
		FB	O	+ 28V for Final unit
		5G		5V LINE GND
		CG		Chassis GND
		FG	O	FINAL GND
RF UNIT (X44-1660-00)				
①	1	ATT1	I	ATT SW data, 0, 20dB : H
	2	ATT2	I	ATT SW data, 0, 10dB : H
②	1	GND		GND
	2	MKR	I	Marker signal (100kHz)
③	1	ATV	I	Bias for ANT switching (TX : H)
	2	RV	I	RX : 15V
④	1	RV	O	RV (RX : 15V) for IF unit
	2	AGC	I	AGC voltage for RF AGC circuit
	3	TB	O	TB (TX : 2.1V) for IF unit
	4	TV	O	TV (TX : 15V) for IF unit
⑤	1	GND		GND
	2	PC	I	Power control (Q3 GAIN control)
	3	TRQ	I	AT STBY signal (Q3 GAIN DOWN)
⑥	1	VCH	O	NC
	2	TB	I	TX : + 15V, RX : -12V
	3	18	I	+ 18V
	4	NC		NC
	5	TV	I	TX : + 15V

Terminal				Terminal Function
No.	Name	I/O		
⑦	1 RB0 2 RB1 3 RB2 4 RB3	I I I I		RX BPF band data
⑧	1 VCL 2 VCM	I I		Main VCO select signal
⑨	1 TCB 2 VC2 3 GND 4 VC1	O I I I		Power supply for PLL unit IC18 VCO3 control voltage GND VCO1, VCO2 control voltage
	RIF TIF XVTR RXA EXTA ANT XVR TXA DRV VCO	O I O I O I I I O O		RX 1st IF (45.05MHz) TX IF (45.05MHz) TX drive output to X. VERTER 7 pin RX signal input To EXT. ANT SW From Antenna connector X. VERTER 4 pin TX POWER Drive output to Final unit VCO signal output to PLL unit
<b>100W FINAL UNIT (X45-1400-00)</b>				
①	1 TXC 2 GND 3 TH	I I O		TX control, TX : 15V GND Final thermal sensor
	IN OUT 28 GND	I O I I		Drive power input Power output + 28V GND
<b>DC-DC UNIT (X46-1030-00)</b>				
①	1 HV 2 FG 3 FH 4 5V 5 GND	O O O O I		High voltage for display drive (approx. -40V) Filament voltage for display + 5V for Digital C unit GND
②	1 DIM 2 GND 3 5V	I I I		DIM SW OFF : 0V GND + 5V
③	1 21B 2 -C	I O		+ 21V for AVR UNIT -40V for -12V power supply for Control unit
<b>IF UNIT (X48-1430-00)</b>				
①	1 I01 2 GND 3 LN1 4 GND 5 MSL 6 GND 7 MIN 8 GND 9 REC	O I I I I I I I O		IF OUT1 (8.83MHz) GND PHONE IN GND Mic select signal for ACC2-9 pin GND TX AFSK signal for ACC2-11 pin GND RX AFSK signal for ACC2-3 pin
②	1 MIC 2 GND	I I		Mic input GND
③	1 MV1 2 MVG 3 SFT 4 PRL	O O O I		MIC GAIN VR Mic line GND To PROC-OUT VR (SSB, FSK mode TX : 15V) PROC-OUT VR (DC)
④	1 TBK 2 -12 3 CR3 4 GND 5 CWG	I I O I O		TX : 15V -12V CR3 for SIDE TONE (100kHz) GND CWG for Control unit, CW mode : 0V
⑤	1 TM 2 MA 3 SSB 4 CWB	I O O O		TX meter amp AM, SSB mode : 15V MOD data for SW unit (A), SSB mode : 15V MOD data for SW unit (A), CW mode : 15V
⑥	1 ALC 2 GND 3 MON	I I O		ALC for TX IF control GND TX IF for SSB, FSK, AM monitor (8.83MHz)

# TS-940S TERMINAL FUNCTION

Terminal			Terminal Function	
No.	Name	I/O		
⑦	1 NG1	I	Noise blanker gate input	
	2 NBB	O	+ B for Noise blanker circuit	
	3 GND		GND	
	4 NA	O	IF output for Noise blanker	
⑧	1 GND		GND	
	2 5IF	I	+ 5V	
⑨	1 USB	O	USB, CW, AM, FM, TUNE : H	} CAR 1 f shift
	2 LSB	O	LSB, FSK : H	
	3 5V	O	+ 5V for CAR unit	
	4 15V	O	+ 15V for CAR UNIT	
⑩	1 RB	I	Bias for RX circuit, RX : 2.1V	
	2 15V	I	+ 15V	
	3 TRQ	I	AT STBY signal	
	4 FMB	O	FM : 15V	} Mode data for Control unit
	5 AMB	O	AM : 15V	
⑪	1 GND		GND	
	2 CR0	I	Carrier for TX CW, FM (8.83MHz)	
⑫	1 USG	I	USB KEY	} KEY ON : L
	2 LSG	I	LSB KEY	
	3 FSG	I	FSK KEY	
	4 AMG	I	AM KEY	
	5 FMG	I	FM KEY	
	6 CWG	I	CW KEY	
	7 WN	I	WIDE/NAR & IF Filter switching data	
	8 MD2	I	IF Filter switching data	
	9 MD1	I	IF Filter switching data	
⑬	1 TV	I	TX : 15V	
	2 RV	I	RX : 15V	
	3 TB	I	Low voltage for TX circuit	
	4 AGC	O	AGC output for RF unit RF AGC	
⑭	1 CV1	O	DC for CAR VR, CW, AM mode TX : 15V	
	2 CV2	I	CAR VR output	
⑮	1 M	O	Meter output	
	2 NAF	O	DC for AGC SW, SSB, FSK, CW mode : 15V	
	3 AGS	I	AGC SLOW : 15V, Normally : -12V	
	4 AG0	I	AGC OFF : 15V	
⑯	1 FMI	O	FM IF (455kHz)	
	2 GND		GND	
	3 GND		GND	
	4 NG2	I	Noise gate (3rd MIX) control signal for NB2	
⑰	1 GND		GND	
	2 CR2	I	CAR2 input (9.285MHz)	
⑱	1 GND		GND	
	2 CR1	I	CAR1 input (455kHz)	
⑲	1 PRS	I	SSB mode PROC SW ON : 15V	
	2 PRM	O	PROC meter	
	3 MVG	GND	GND	
	4 MV2	I	MIC GAIN/PROC-IN VR	
⑳	1 GND		GND	
	2 IO2	O	IF OUT 2 (100kHz)	
㉑	1 GND		GND	
	2 CR4	O	CAR4 for SIDE TONE (99.2kHz)	
	3 MUT	I	SQL MUT signal, Muting : H	
	4 FMV	I	FM Detector signal	
	5 GND		GND	
㉒	1 AP0	I	CW mode AF TUNE OFF : 15V	
	2 AP5	I	CW mode AF TUNE ON : 15V	
	3 AP4	O	AF TUNE VR	
	4 AP2	I	} CW PITCH VR	
	5 AP1	O		
	6 AP3	I	AF TUNE VR	
	7 NTH	I	NOTCH VR	
	8 CWP	I	CW PITCH VR	
㉓	1 AV1	O	AF GAIN VR	
	2 AVG	GND	GND	
	3 GND		GND	
	4 RFG	O	RF GAIN VR	

Terminal			Terminal Function	
No.	Name	I/O		
㉔	1 FSB	O	FSK mode data, FSK : 15V	
	2 GND		GND	
	3 AFS	I	AFSK modulate signal (2290/2125Hz)	
	TIF	O	TX IF signal (45.05MHz)	
	RIF	I	RX 1st IF signal (45.05MHz)	
	HET	I	HET (36.22MHz)	
PLL UNIT (X50-2020-00)				
㉕	1 DA0	O	} PLL data for CAR1, CAR2	
	2 DA1	O		
	3 DA2	O		
	4 DA3	O		
	5 UL1	I	Unlock signal	
㉖	1 GND		GND	
	2 DA0	I	} PLL data	
	3 DA1	I		
	4 DA2	I		
	5 DA3	I		
	6 CL2	I	Data clock for IC8	
	7 CL1	I	Data clock for IC9	
	8 CL0	I	Data clock for IC19	
㉗	1 GND		GND	
	2 117	I	117MHz from CAR unit	
㉘	1 FMM	I	FM modulate signal	
	2 GND		GND	
	3 15A	I	+ 15V	
	4 UL	O	PLL unlock signal	
	5 5	I	+ 5V	
㉙	1 KFS	I	RTTY KEY signal, KEY DOWN : L	
	2 GND		GND	
	3 MKR	O	100kHz marker signal output	
	4 MKG		NC	
	5 GND		GND	
	6 MKS		Marker ON : L, Normally : H	
㉚	1 AFS	O	AFSK signal (2290/2125Hz)	
	2 GND		NC	
	3 FSB	I	FSK mode data, FSK : 15V	
㉛	1 10	O	10MHz for CAR unit	
	2 GND		GND	
㉜	1 TCB	I	Power supply for IC18	
	2 VC2	O	Control voltage for RF unit VCO3	
	3 GND		GND	
	4 VC1	O	Control voltage for RF unit VCO1, 2	
㉝	1 GND		GND	
	2 PLE	I	Data latch for IC17	
	3 CL3	I	Clock for IC17	
	4 PLD	I	PLL data IC17	
	HET	O	HET for RF unit (36.22MHz)	
	VCO	I	Output signal of RF unit, VCO1, 2 and 3	
LPF UNIT (X51-1330-00)				
㉞	1 VSF	O	Forward detect for SWR	
	2 GND		GND	
	3 VSR	O	Reverse detect for SWR	
	4 GND		GND	
㉟	1 ANT	O	LPF unit output	
㊱	1 GND		GND	
	2 XVR	I	X. VERTER 4 pin	
㊲	1 TXC	O	TX control for Final unit, TX : 15V	
	2 GND		GND	
	3 TH	I	Final thermal sensor	
㊳	1 LP2	I	} LPF band data	
	2 LP0	I		
	3 LP1	I		
㊴	1 M0	O	Fan control	
	2 GND		GND	

# TERMINAL FUNCTION TS-940S

Terminal				Terminal Function
No.	Name	I/O		
⑦	1	21B	I	+ 21V for AVR unit
	2	28	I	+ 28V
	3	TV	I	TX : 15V
	4	BTP	O	PROTECTION signal (H : TX OFF)
		IN	I	LPF unit input
<b>CONTROL UNIT (X53-1420-11)</b>				
①	1	VCH	I	NC
	2	TB	O	TB for RF unit, TX : 2.1V
	3	GND		GND
	4	TV	O	TV for RF unit, TX : 15V
	5	18	O	+ 18V for RF unit
②	1	TRQ	I	AT STBY signal, TUNE : Power down
	2	15B	O	+ 15V for AT unit
	3	21B	O	+ 21V for AT unit
	4	TV	O	TV for AT unit
③	1	GND		GND
	2	28C	I	+ 28V
	3	21B	O	+ 21V for AVR unit
	4	21T	I	+ 21V
④	1	EX2		} For REMOTE connector, TX : Connecto to EX1, EX2
	2	EX1		
⑤	1	8C		+ 8V for SW unit (L)
	2	TMY		TIMER SW ON : 0V
	3	GND		GND
⑥	1	RV	O	RV for RF unit, TX : 15V
	2	ATV	O	ANT switching output for RF unit (TX : H)
⑦	1	AT0	I	NC
	2	WRC	I	NC
⑧	1	GND		GND
	2	VSF	I	Forward detect for SWR
	3	GND		GND
	4	VSR	I	Reverse detect for SWR
	5	BTP	I	Protection input
	6	TV	O	TV for LPF unit, TX : 15V
	7	28	O	+ 28V for LPF unit
	8	21B	O	+ 21V for LPF unit
⑨	1	GND		GND
	2	TRQ	O	AT STBY signal for RF unit
⑩	1	15B	O	+ 15V for IF unit
	2	TBK	O	TBK for IF unit, TX : 15V
	3	RB	O	RB for IF unit, RX : 2.1V
	4	-12	O	-12V for IF unit
⑪	1	-12	O	-12V for SW unit
	2	TRQ	O	AT STBY signal for SW unit
	3	PC0	I	TRQ-H : H, Normally : -12V
	4	PC1	I	} Power control VR
	5	PC2	O	
⑫	1	ALC	O	ALC for IF unit
	2	GND		GND
⑬	1	VCM	O	VC meter
	2	ALM	O	ALC meter
	3	ICM	O	IC meter
	4	GND		GND
	5	SWR	O	SWR meter
	6	PWR	O	POWER meter
⑭	1	GND		GND
	2	VX2	I	VOX GAIN VR
⑮	1	NC		NC
	2	ISW	O	SWR voltage for AT unit
	3	GND		GND

Terminal				Terminal Function
No.	Name	I/O		
⑯	1	RRL	I	Connect to TV
	2	RLT	O	TX : GND, Normally : OPEN
	3	TV	O	TX : 15V
	4	RAL	I	ALC input
	5	XAL	I	ALC input
	6	XRL	O	Relay control } X. VERTER
⑰	1	BLK	I	Dial click blanking pulse
	2	-C	I	-40V for -12V power supply
	3	21B	O	+ 21V for DC-DC unit
	4	BZ	I	Buzzer pulse
	5	DST	I	BAND data for TX.OFF
⑱	1	UL	O	PLL unlock signal for Digital B unit
	2	TR	O	TR (TX : 15V) for Digital B unit
⑲	1	NG1	O	Noise blanker gate
	2	NBB	I	+ B for noise blanker circuit
	3	GND		GND
	4	NA	I	IF for noise blanker (8.83MHz)
⑳	1	15B	I	+ 15V
	2	NB2	I	NB2 SW
	3	NB1	I	NB1 SW
㉑	1	UL	I	Unlock signal (L : TX.OFF)
	2	15A	O	+ 15V for PLL unit
	3	5	O	+ 5V for PLL unit
	4	GND		GND
㉒	1	DLY	O	DLAY VR
	2	VXC	O	ANTI VOX VR
	3	V15	O	+ 15V for SW unit
㉓	1	GND		GND
	2	5CO	I	+ 5V
㉔	1	NG2	O	NB2 blanking signal
	2	GND		GND
㉕	1	GND		GND
	2	MON	I	TX IF for SSB, FSK, AM monitor (8.83MHz)
㉖	1	15B	O	+ 15V for SW unit
	2	MS	I	Power supply for monitor circuit
㉗	1	SS	I	SEND or PTT switch data (L : TX)
	2	FBK	I	CW mode FULL/SEMI SW FULL : 15V
	3	VS1	I	AM, SSB mode VOX SW ON : 15V
	4	VS2	I	CW mode VOX SW ON : 15V
㉘	1	MUT	O	SQL MUT signal (Muting : H)
	2	AMB	I	AM mode data, AM : 15V
	3	CWG	I	CW mode data, CW : 0V
	4	FMB	I	FM mode data, FM : 15V
	5	TRQ	O	AT STBY signal for IF unit
㉙	1	SQ1	O	SQL VR output
	2	SQ2	I	SQL VR input
㉚	1	GND		GND
	2	CR0	I	CAR0 for SSB, FSK, AM monitor (8.83MHz)
㉛	1	ANV	I	ANTI VOX VR
	2	GND		GND
㉜	1	FMC	I	FM MIC GAIN VR
	2	MVG	I	GND
㉝	1	FMM	O	FM Mic amp
	2	GND		GND
㉞	1	FIN	I	FM IF input (455kHz)
	2	GND		GND
㉟	1	CR4	I	CAR4 for side tone (99.2kHz)
	2	GND		GND
	3	GND		GND
	4	CR3	I	CAR3 for side tone (100kHz)

# TS-940S TERMINAL FUNCTION

Terminal				Terminal Function
No.	Name	I/O		
③⑥	1	SP1	O	Audio signal for REMOTE 1pin
	2	GND		GND
	3	GND		GND
	4	SP2	O	Audio signal for EXT. SP
	5	KEY	I	KEY UP : H, Normally : L
	6	STK	I	KEY DOWN : L, Normally : H
③⑦	1	AV2	I	AF GAIN VR
	2	AVG		GND
③⑧	1	SP2	I	Audio signal from PHONE
	2	GND		GND
	3	GND		GND
	4	SP1	O	Audio signal from PHONE
③⑨	1	VO	I	VS-1 (option) voice signal
	2	GND		GND
④⑩	1	GND		GND
	2	FMV	O	FM detector output
④⑪	1	ICB	I	Detect terminal for IC meter
	2	ICA	I	Detect terminal for VC, IC meter
④⑫	1	AR	O	ON AIR LED light on
	2	GND		GND
④⑬	1	8V	O	+ 8V for VS-1 (option)
	2	GND		GND
		SS	I	REMOTE 4 pin, EXT. STBY
<b>DIGITAL A UNIT (X54-1830-00)</b>				
①	1	LOCK	O	F. LOCK segment data
	2	SC	O	Scale display data
	3	G5	O	Grid data
	4	G4	O	
	5	G3	O	
	6	G2	O	
	7	G1	O	
	8	G9	O	
	9	G10	O	
	10	G8	O	
	11	G7	O	
	12	G6	O	
②	1	B2	O	Multiplex segment data
	2	B3	O	
	3	B4	O	
	4	B5	O	
	5	B6	O	
	6	B7	O	
③	1	B1	O	Segment data DP
	2	B0	O	Segment data g
	3	C3	O	Segment data P10
	4	C2	O	Segment data P9
	5	C1	O	Segment data P8
	6	C0	O	Segment data P7
	7	C6	O	Segment data control
	8	C7	O	
④	1	LP2	O	LPF BAND data
	2	LP1	O	
	3	LP0	O	
	4	WRC	O	NC
	5	WRC	O	AT BAND data
	6	AT0	O	NC
	7	AT0	O	AT BAND data
	8	AT1	O	
	9	AT2	O	
	10	AT3	O	

Terminal				Terminal Function
No.	Name	I/O		
⑤	1	DA0	O	} PLL data for PLL, CAR unit
	2	DA1	O	
	3	DA2	O	
	4	PLD	O	PLL data for PLL unit IC17
	5	PLE	O	Data latch for PLL unit IC17
	6	CL3	O	Clock for PLL unit IC17
	7	CL2	O	Clock for PLL unit IC8
	8	CL1	O	Clock for PLL unit IC9
	9	CL0	O	Clock for PLL unit IC19
	10	DA3	O	PLL data for PLL, CAR unit
	11	GND		GND
⑥	1	SH	O	SLOPE HIGH cut
	2	SL	O	SLOPE LOW cut
	3	VB	O	VBT } Code select data
⑦	1	CL4	O	PLL clock for CAR1 (455kHz)
	2	CL5	O	PLL clock for CAR2 (9.285MHz)
⑧	1	BZ	O	Buzzer pulse
	2	DST	O	BAND data
	3	BLK	O	Dial click blanking pulse
⑨	1	DIM	I	DIM SW OFF: 0V
	2	SPL	O	SPLIT LED light on
	3	TX	O	STBY control
	4	VCL	O	} Main VCO select signal
	5	VCM	O	
	6	MDD	O	} MODE LED light ON
	7	MD1	O	
	8	MD2	O	WIDE, NAR data, NAR : H
	9	WN	O	
	10	GND		GND
⑩	1	ATS	O	AT start pulse
	2	GND		GND
⑪	1	RC	O	RIT CLEAR pulse
	2	CN	O	Multiplex control data for switches
	3	SL0	O	
	4	SL1	O	} Multiplex select data for switches
	5	SL2	O	
	6	SL3	O	
⑫	1	GND		GND
	2	13	I	} Multiplex switch data
	3	12	I	
	4	11	I	
	5	10	I	
	6	14	I	
	7	15	I	
	8	16	I	
	9	17	I	
⑬	1	RB0	O	} RX BPF band data
	2	RB1	O	
	3	RB2	O	
	4	RB3	O	
	5	HDL	O	HOLD LED light on
	6	PSL	O	PG.S LED light on
	7	MSL	O	M.S LED light on
⑭	1	SB1	O	} LCD display data
	2	SB2	O	
	3	MRQ	O	Data clock for sub $\mu$ -processor
	4	SB3	O	} LCD display data
	5	SB0	O	
	6	GND		GND
⑮	1	GND		GND
	2	5DA	I	+ 5V
	3	10DA	I	+ 10V
⑯	1	5V	O	+ 5V for DC-DC unit
	2	GND		GND
	3	DIM	O	DIM data for DC-DC unit, DIM SW OFF : 0V
⑰	1	GND		GND
	2	ENC	I	Main encoder pulse

Terminal				Terminal Function	
No.	Name	I/O			
⑮	1	VDD	O	+ 5V for photo coupler GND TX data RX data Clear to SEND Request to SEND	ACC1
	2	GND			
	3	TXD	O		
	4	RXD	I		
	5	CTS	I		
	6	RTS	O		
⑰	1	CLK	O	Clock + 10V for interface RADY Control data Chip select Read Write GND	EXT Control board (option)
	2	B	O		
	3	RDY	I		
	4	CD	O		
	5	CS	O		
	6	R	O		
	7	WR	O		
	8	GND			
⑳	1	RES	O	Reset Data 0 Data 1 Data 2 Data 3 Data 4 Data 5 Data 6 Data 7	EXT control board (option)
	2	D0	I/O		
	3	D1	I/O		
	4	D2	I/O		
	5	D3	I/O		
	6	D4	I/O		
	7	D5	I/O		
	8	D6	I/O		
	9	D7	I/O		
CAR UNIT (X54-1840-00 : A/2)					
①	1	15V	I	+ 15V	CAR1 f shift
	2	5V	I	+ 5V	
	3	UL1	O	Unlock signal	
	4	CL4	I	PLL clock for CAR1 (455kHz)	
	5	DA3	I	PLL data for CAR1, CAR2	
	6	DA2	I		
	7	DA1	I		
	8	DA0	I		
	9	CL5	I	PLL clock for CAR2 (9.285MHz)	
	10	LSB	I	LSB, FLS : H	
	11	USB	I	USB, CW, AM, FM, TUNE : H	
②	1	GND		GND	CAR2
	2	CR2	O	CAR2 for IF unit (455kHz)	
	3	GND		GND	
	4	117	O	117MHz for PLL unit	
	5	GND		GND	
	6	10	I	10MHz	
	7	GND		GND	
	8	CR0	O	CAR0 for SSB, FSK AM monitor (8.83MHz)	
	9	GND		GND	
	10	CR0	O	Carrier for TX, CW, FM (8.83MHz)	
	11	GND		GND	
	12	CR1	O	CAR1 for IF unit (455kHz)	
DIGITAL B UNIT (X54-1840-00 : B/2)					
①	1	GND		GND	Main encoder pulse input
	2	ME1	I		
	3	ME2	I		
	4	5V	O	+ 5V for main encoder	
②	1	TRQ	I	AT STBY signal, Tuning : H	ATT SW data
	2	AS1	O		
	3	AS2	I		
	4	ATB	I	ATT-THRU : 21V	
③	1	GND		GND	Multiplex switch data
	2	17	O		
	3	16	O		
	4	15	O		
	5	14	O		
④	1	UL	I	Unlock signal	TX : 15V
	2	TR	I		
⑤	1	MU	I	MIC UP	MIC DOWN + 8V for MIC connector
	2	MD	I		
	3	8C	O		

Terminal				Terminal Function	
No.	Name		I/O		
⑥	1	M▶V	I	M▶ VFO KEY M. IN KEY F. LOCK KEY SPLIT KEY A/B KEY BAND DOWN KEY BAND UP KEY ATT KEY GND } SW ON : L	
	2	MIN	I		
	3	LOK	I		
	4	SPT	I		
	5	A/B	I		
	6	BD	I		
	7	BU	I		
	8	ATT	I		
	9	GND	I		
⑦	1	10	I	10Hz digit display data	
	2	100	I	1MHz 100kHz switching signal	
	3	MB0	I	Memory bank SW, 2, 3 : H	
	4	MB1	I	Memory bank SW, 1, 3 : H	
⑧	1	B3	I	} 10 KEY (BAND) matrix data	
	2	B2	I		
	3	B1	I		
	4	B0	I		
	5	M/V	I	M/V KEY	} KEY ON : L
	6	TFS	I	TFS KEY	
	7	A=B	I	A=B KEY	
	8	VRC	I	VOICE KEY	
⑨	1	VB0	I	Bit 0	} Code data for VBT, SLOPE TUNE
	2	VB1	I	Bit 1	
	3	VB2	I	Bit 2	
	4	VB3	I	Bit 3	
	5	VB4	I	Bit 4	
⑩	1	ENT	I	ENT KEY	} KEY ON : L
	2	MCE	I	MCE KEY	
	3	NRQ	O	TRQ output for keyboard ass'y	
	4	WIDE	I	NAR/WIDE SW, WIDE : 15V	
	5	M2	I	} MODE KEY matrix data	
	6	M1	I		
	7	M0	I		
	8	RCL	I	RIT CLEAR KEY	} KEY ON : L
	9	XIT	I	XIT KEY	
	10	RIT	I	HOLD KEY	
	11	HLD	I	HOLD KEY	
	12	PSC	I	PG.S KEY	
	13	MS	I	MS KEY	
⑪	1	RC	I	RIT CLEAR pulse	} Multiplex control data for switches
	2	CN	I	Multiplex control data for switches	
	3	13	O		
	4	12	O	} Multiplex switch data	
	5	11	O		
	6	10	O		
	7	SL3	I	} Multiplex select data for switches	
	8	SL2	I		
	9	SL1	I		
	10	SL0	I		
⑫	1	GND	I	GND	} RIT encoder pulse 2 RIT encoder pulse 1 + 5V for RIT encoder
	2	RE2	I		
	3	RE1	I		
	4	5V	O		
⑬	1	HS	I	LCD DATA accept message	} + 8V for MIC connector + 5V GND
	2	8B	I		
	3	5C	I		
	4	GND	I		
⑭	1	GND	I	GND	} Main encoder pulse output
	2	ENC	O		
DIGITAL C UNIT (X54-1850-00)					
①	1	B2	I	} Multiplex segment data	
	2	B3	I		
	3	B4	I		
	4	B5	I		
	5	B6	I		
	6	B7	I		

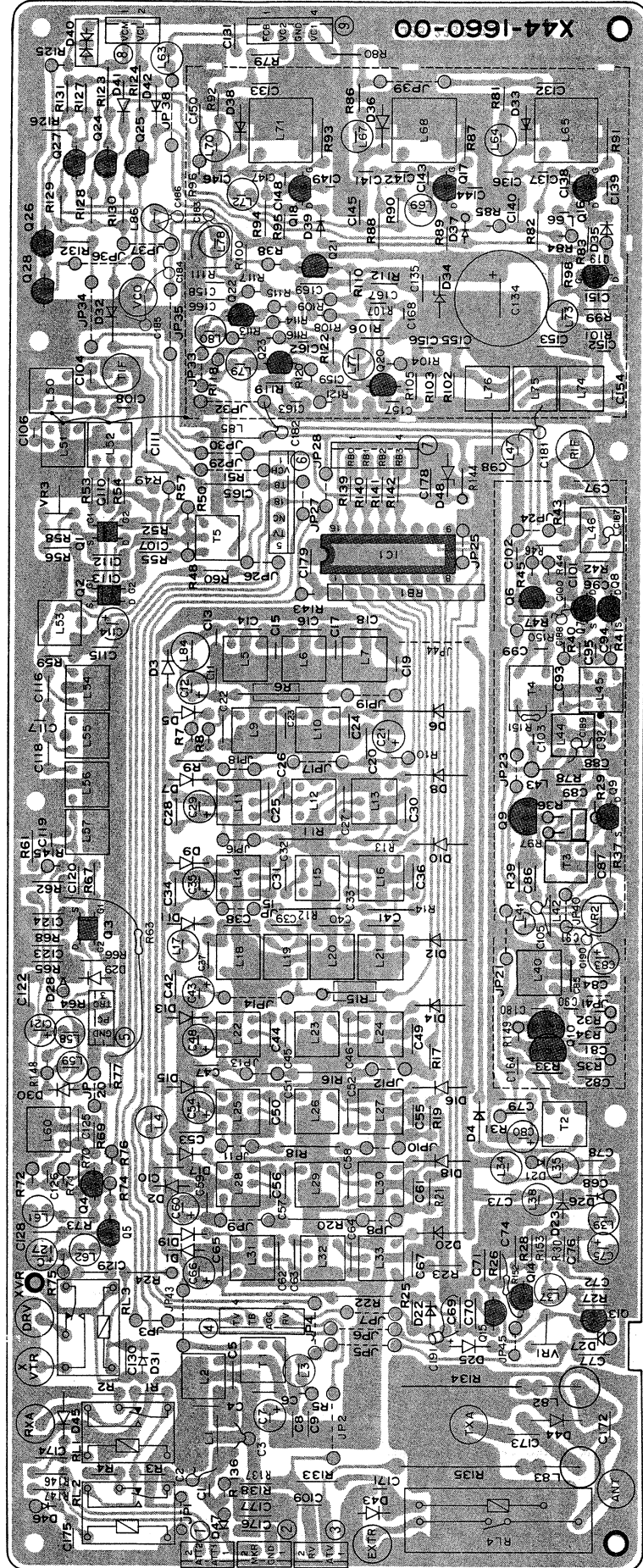
Terminal				Terminal Function
No.	Name	I/O		
②	1	G1	I	} Grid data
	2	G2	I	
	3	G3	I	
	4	G4	I	
	5	SC	I	Scale data
③	1	5V	I	+ 5V
	2	GND		GND
	3	HV	I	—40V for drive display tube
④	1	B0	I	Segment data DP
	2	B1	I	Segment data g
	3	C0	I	Segment data P10
	4	C1	I	Segment data P9
	5	C2	I	Segment data P8
	6	C3	I	Segment data P7
	7	C6	I	} Segment control data
	8	C7	I	
⑤	1	G5	I	} Grid data
	2	G6	I	
	3	G7	I	
	4	G8	I	
	5	G9	I	
	6	G10	I	
	7	LOCK	I	Segment data F. LOCK
⑥	1	FH	I	} Filament voltage for display
	2	FG	I	
⑦	1	f	O	Segment data f
	2	LOCK	O	LOCK display data
	3	FH	O	Heater for display tube
	4	VFO A	O	VFO A display data
	5	VFO B	O	VFO B display data
	6	G10	O	Grid data No. 10
	7	d	O	Segment data d
	8	e	O	Segment data e
⑧	1	G9	O	Grid data No. 9
	2	G8	O	Grid data No. 8
	3	P1	O	} Analog digit data
	4	P2	O	
	5	G7	O	Grid data No. 7
	6	P3	O	} Analog digit data
	7	P4	O	
	8	G6	O	Grid data No. 6
	9	P10	O	Analog digit data
	10	G5	O	Grid data No. 5
	11	P9	O	Analog digit data
	12	MEMO	O	MEMO display data
⑨	1	g	O	Segment data g
	2	c	O	Segment data c
	3	G4	O	Grid data No. 4
	4	P8	O	Analog digit data
	5	G3	O	Grid data No. 3
	6	P7	O	} Analog digit data
	7	P6	O	
	8	G2	O	Grid data No. 2
	9	P5	O	Analog digit data
	10	G1	O	Grid data No. 1
	11	b	O	Segment data b
	12	—	O	— (minus) display data
⑩	1	SC	O	Scale display data
	2	a	O	Segment data a
	3	DP	O	Dot display data
	4	FG	O	Heater for display tube
	5	RIT	O	RIT display data
	6	XIT	O	XIT display data
AT UNIT (B) (X57-1130-00)				
①	1	GND		GND
	2	ATS	I	AT start pulse

Terminal				Terminal Function
No.	Name	I/O		
②	1	15B	I	+ 15V
	2	TRQ	O	AT STBY signal for Control unit
	3	TV	I	TX : 15V
③	1	TRQ	O	AT STBY signal for Digital B unit
	2	AS1	I	} ATT KEY signal (ATT ON : L) confirmation signal for AT installed.
	3	AS2	O	
	4	ATB	O	AT THRU : 21V
④	1	ATB	I	AT THRU : 21V
	2	TRQ	O	AT STBY signal for MB control
	3	TV	O	TX : 15V
	4	MB	I	Tuning : 14V
⑤	1	GND		GND
	2	10	O	+ 10V
	3	5	O	+ 5V
	4	14	O	+ 14V
	5	21B	O	+ 21V
⑥	1	28		NC
	2	21B	I	+ 21V
⑦	1	ATV	O	TX : 15V
	2	TNQ	O	AT STBY signal for SW unit (L)
AT UNIT (B) (X57-1130-00)				
⑧	1	ATH	O	AT LED anode
	2	ATL	I	AT LED cathode
⑨	1	ATB	I	AT THRU : 21V
	2	TRQ	I	AT STBY signal for MB control
	3	TV	I	TX : 15V
	4	MB	O	Tuning : 14V
⑩	1	MB	O	Tuning : 14V
	2	GND		GND
	3	21B	O	+ 21V for AT unit (C)
⑪	1	ATI	I	AT IN : 15V
	2	LED	O	TUNE LED light on
⑫	1	21B	I	+ 21V
	2	5	I	+ 5V
	3	10	I	+ 10V
	4	14	I	+ 14V
	5	GND		GND
⑬	1	GND		GND
	2	ISW	I	SWR level
⑭	1	M1—	O	} Tuning motor control
	2	M1+	O	
	3	M2—	O	
	4	M2+	O	
AT UNIT (C)				
⑮	1	WRC	I	} AT BAND data
	2	AT0	I	
	3	AT1	I	
	4	AT2	I	
	5	AT3	I	
⑯	1	21B	I	+ 21V
	2	GND		GND
	3	MB	I	Tuning : H
⑰	1	M1—	O	} Magnetic brake relay terminal for AT tune finish
	2	M1+	O	
	3	M2—	O	
	4	M2+	O	

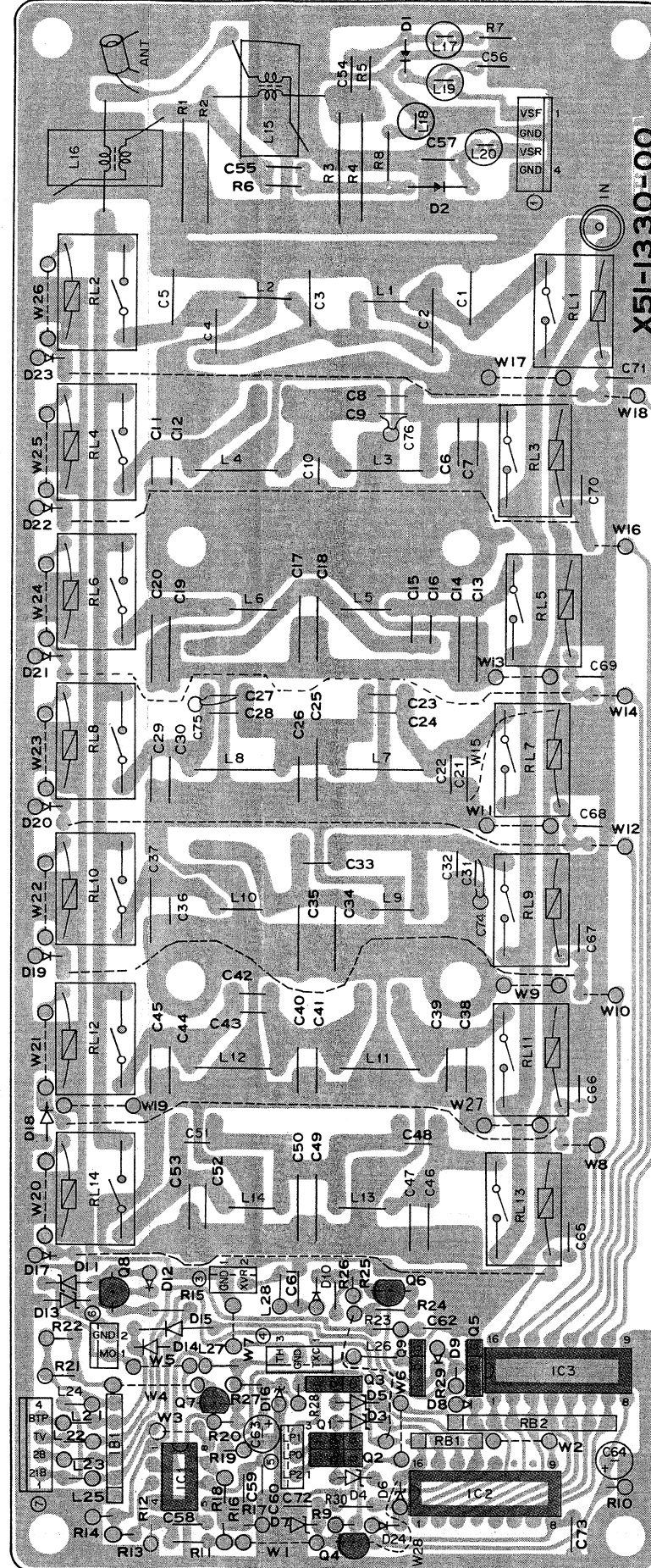


# TS-940S PC BOARD VIEWS

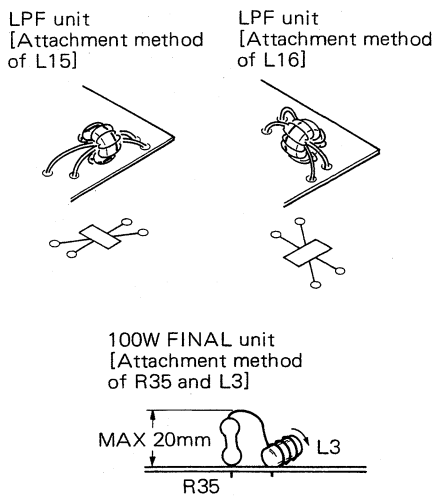
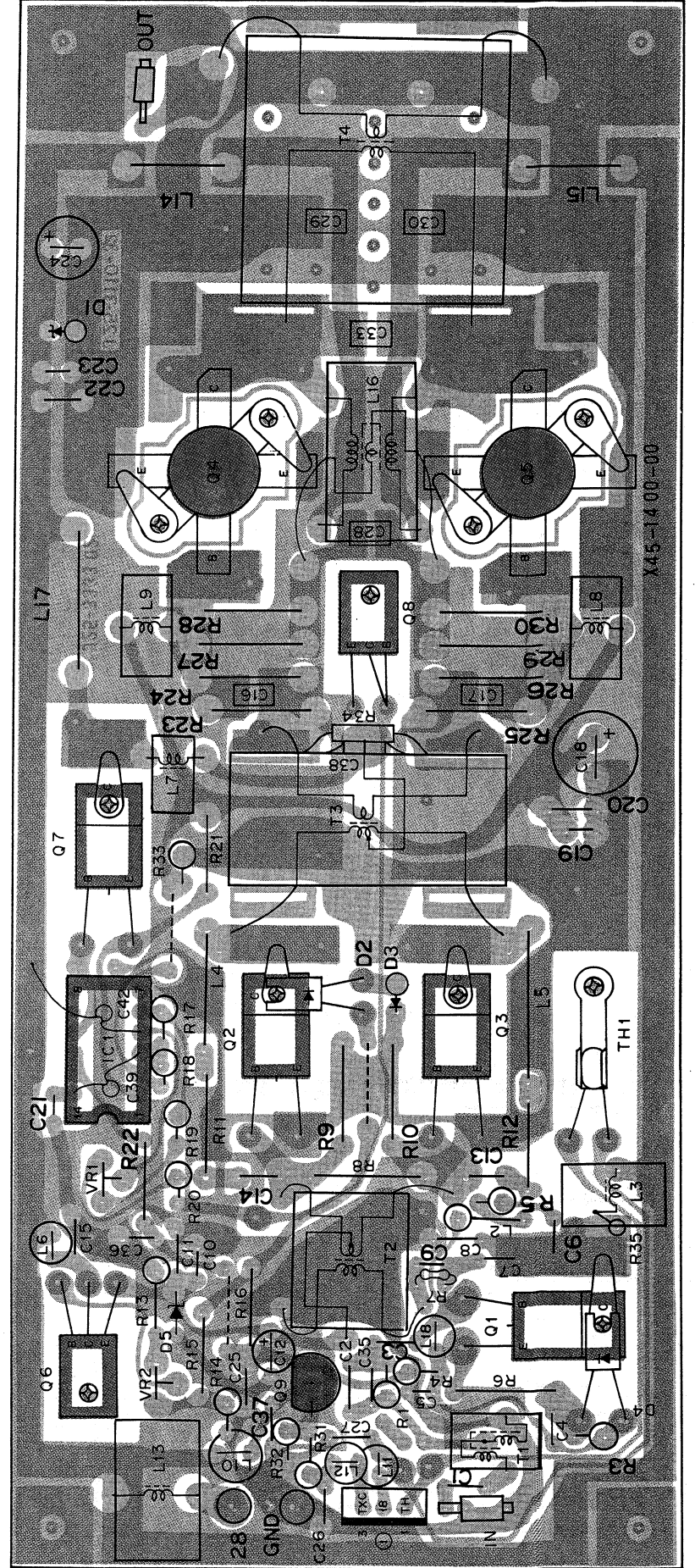
RF UNIT (X44-1660-00) Component side view



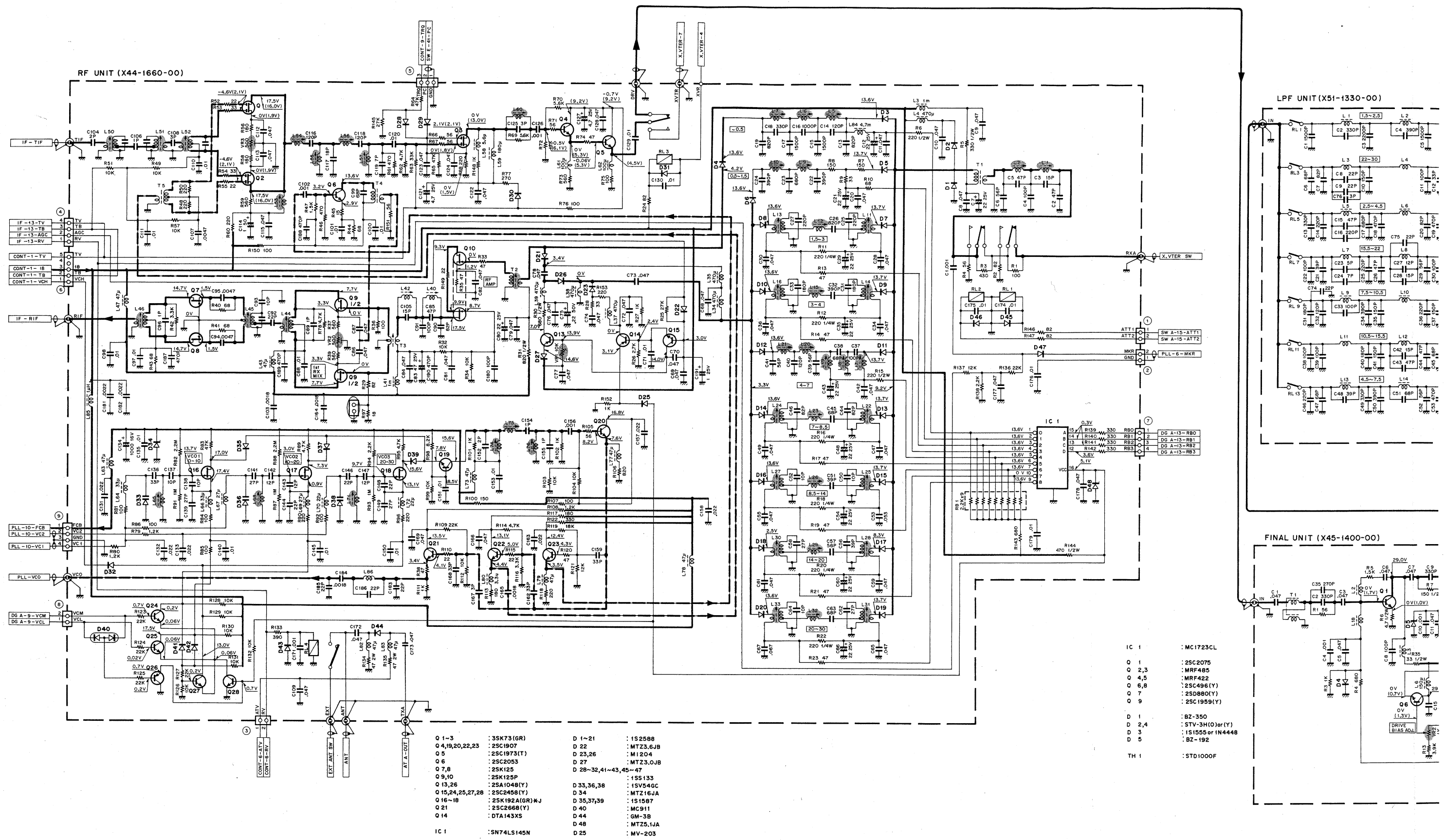
LPF UNIT (X51-1330-00) Component side view



100W FINAL UNIT (X45-1400-00) Component side view







RF UNIT (X44-1660-00)

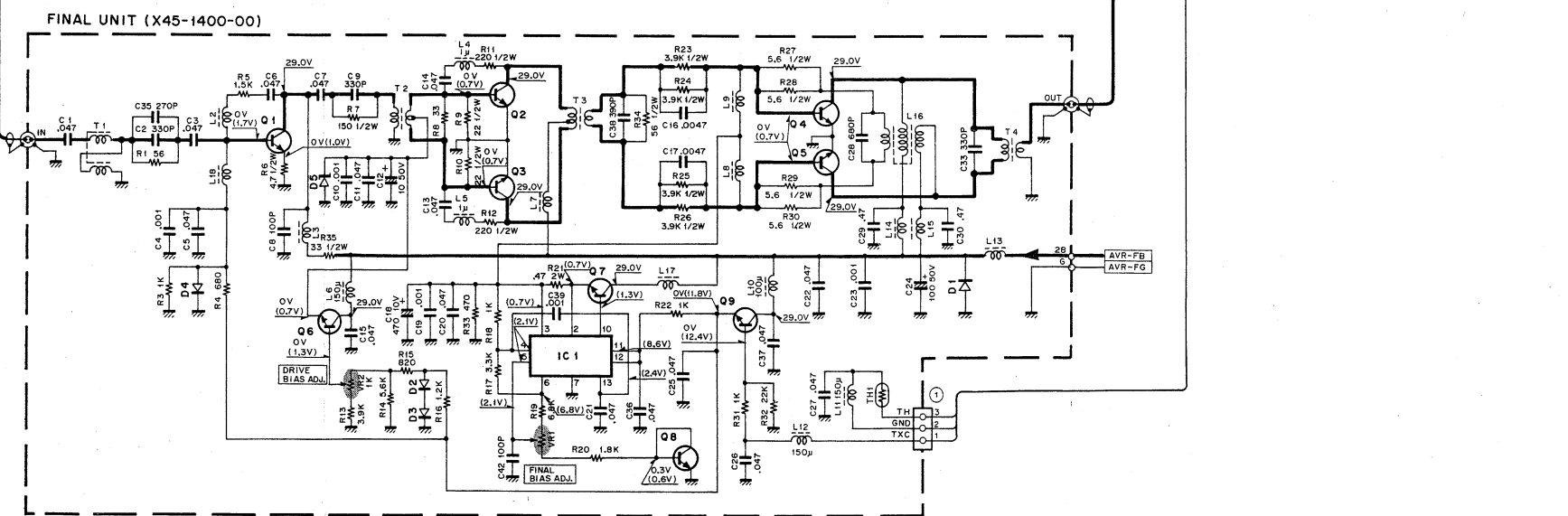
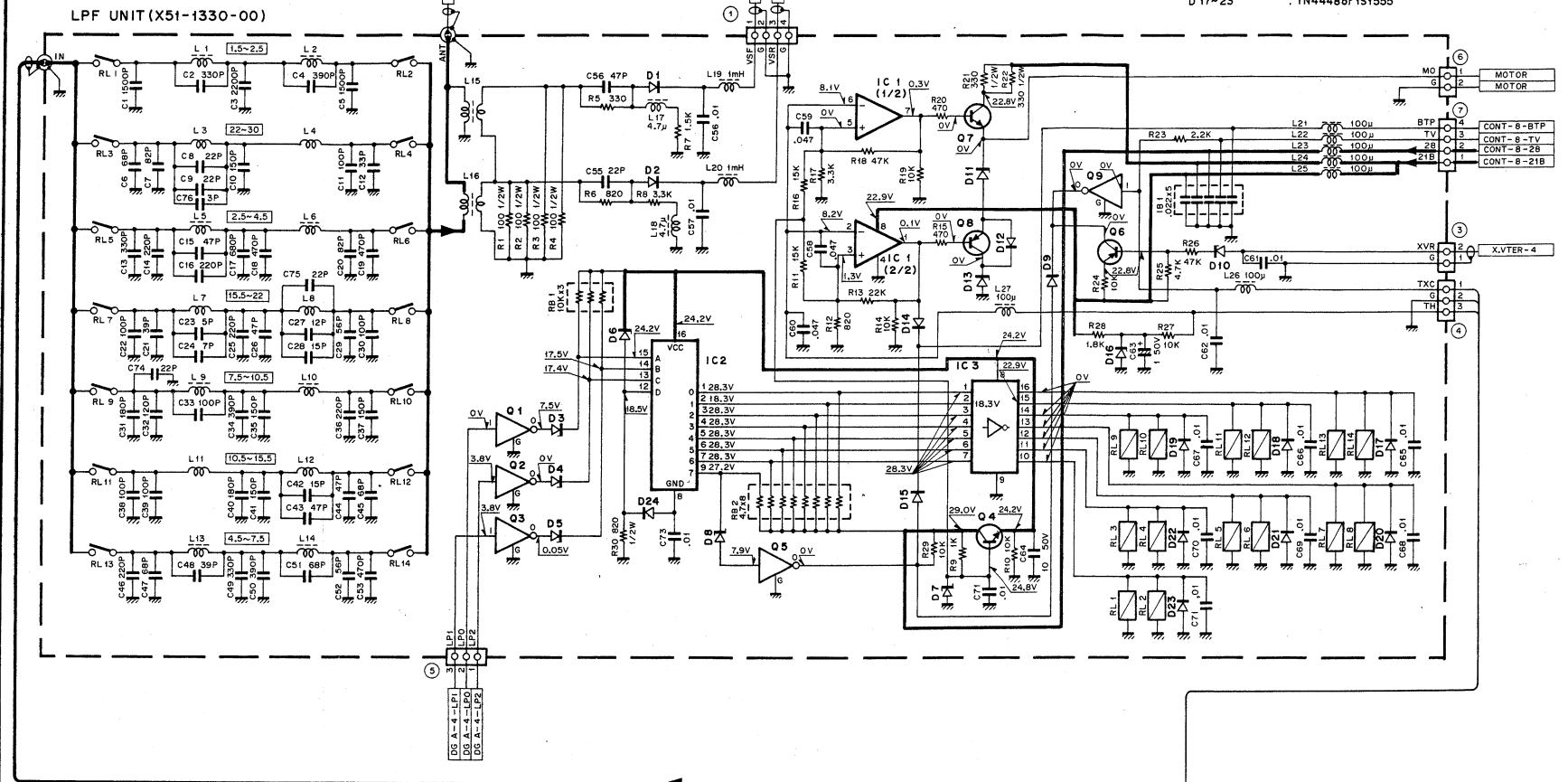
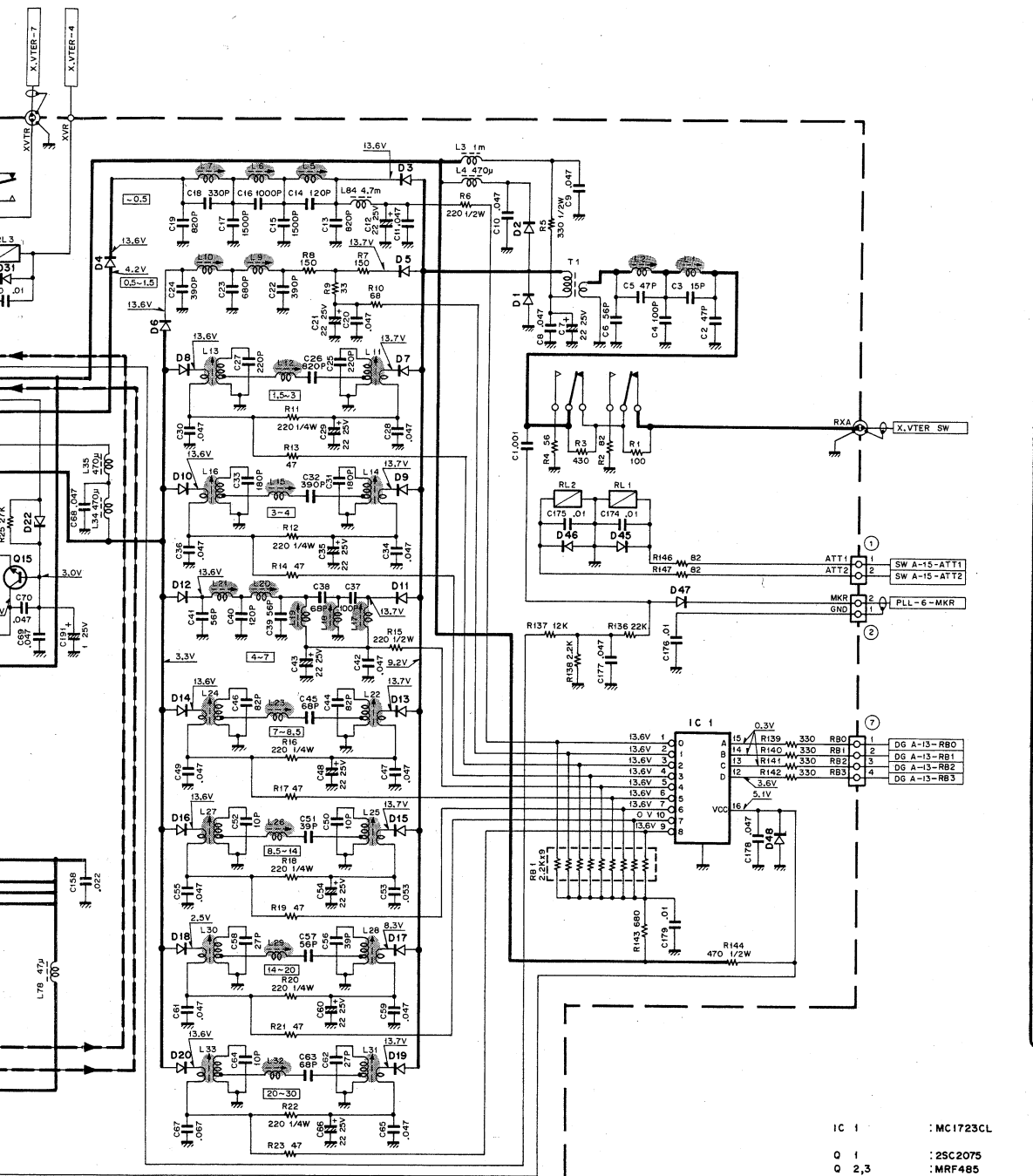
LPF UNIT (X51-1330-00)

FINAL UNIT (X45-1400-00)

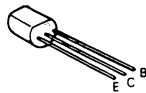
- |                  |                 |                     |            |
|------------------|-----------------|---------------------|------------|
| Q 1-3            | : 3SK73(GR)     | D 1-21              | : 1S2588   |
| Q 4,19,20,22,23  | : 2SC1973(T)    | D 22                | : MT23.6JB |
| Q 5              | : 2SC2053       | D 23,26             | : M1204    |
| Q 6              | : 2SK125        | D 27                | : MT23.0JB |
| Q 7,8            | : 2SK125        | D 28-32,41-43,45-47 | : 1S5133   |
| Q 9,10           | : 2SK125P       | D 33,36,38          | : 1S5133   |
| Q 13,26          | : 2SA1048(Y)    | D 34                | : 1S5133   |
| Q 15,24,25,27,28 | : 2SC2458(Y)    | D 35,37,39          | : 1S1587   |
| Q 16-18          | : 2SK192A(GR)WJ | D 40                | : MC911    |
| Q 21             | : 2SC2668(Y)    | D 44                | : GM-3B    |
| Q 14             | : DTA143XS      | D 48                | : MT25.1JA |
| IC 1             | : SN74LS145N    | D 25                | : MV-203   |

- |       |                   |
|-------|-------------------|
| IC 1  | : MC1723CL        |
| Q 1   | : 2SC2075         |
| Q 2,3 | : MRF485          |
| Q 4,5 | : MRF422          |
| Q 6,8 | : 2SC496(Y)       |
| Q 7   | : 2SD880(Y)       |
| Q 9   | : 2SC1959(Y)      |
| D 1   | : BZ-350          |
| D 2,4 | : STV-3H(O)or(Y)  |
| D 3   | : 1S1555or 1N4448 |
| D 5   | : BZ-192          |
| TH 1  | : STD1000F        |

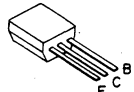
# CIRCUIT DIAGRAM TS-940S



## TS-940S CIRCUIT DIAGRAM

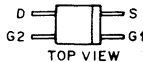


2SA1048  
2SC2458  
2SC2459  
2SC2668



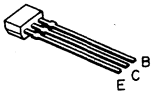
2SK125  
2SK30A

3SK73



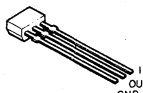
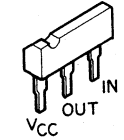
2SK192A

2SC2787



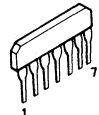
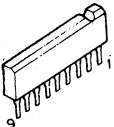
DTA143EF

DTC114ES

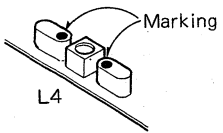


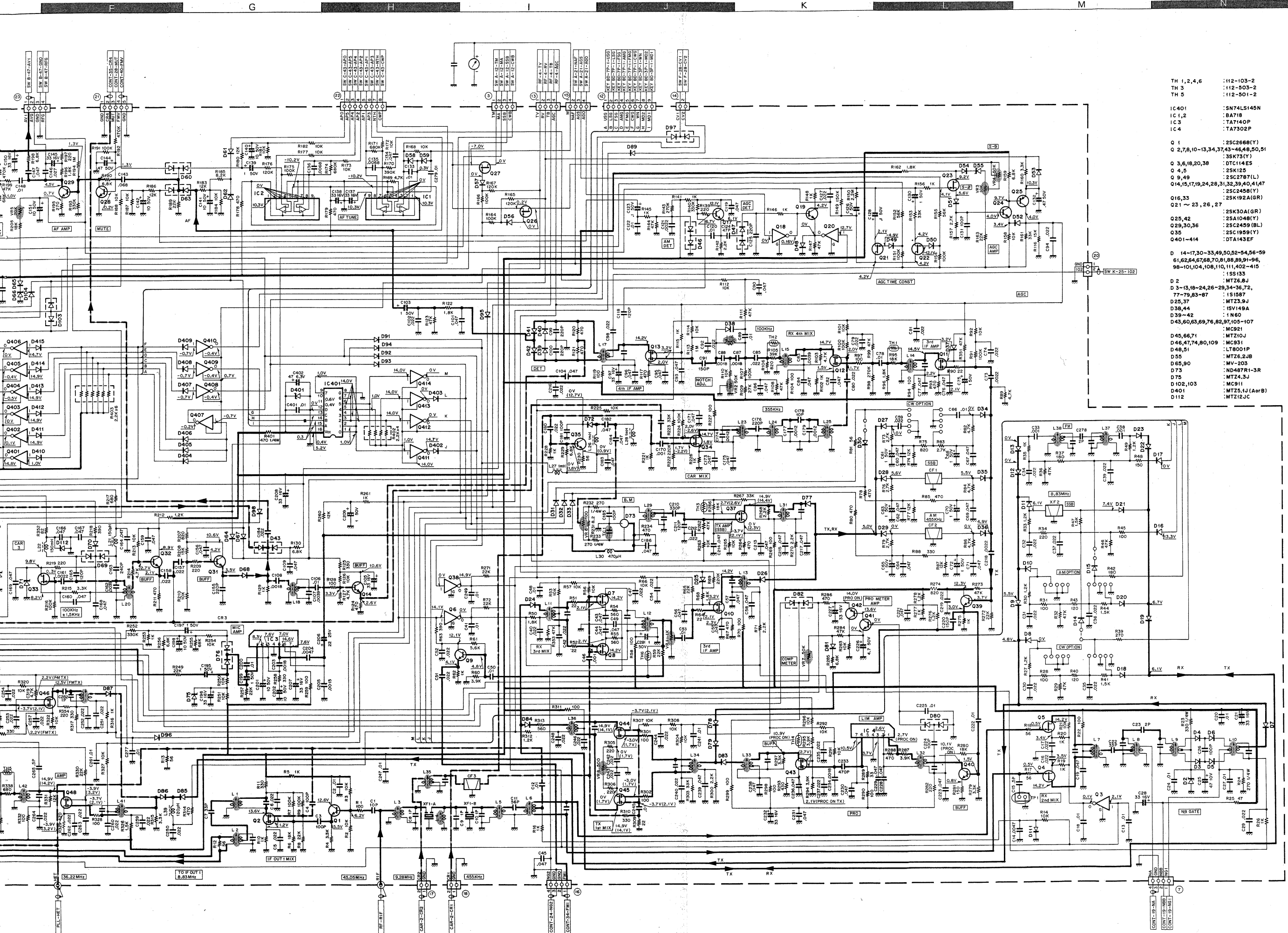
BA718

TA7140P  
TA7302P



[Attachment method  
of XF 1-A, B]

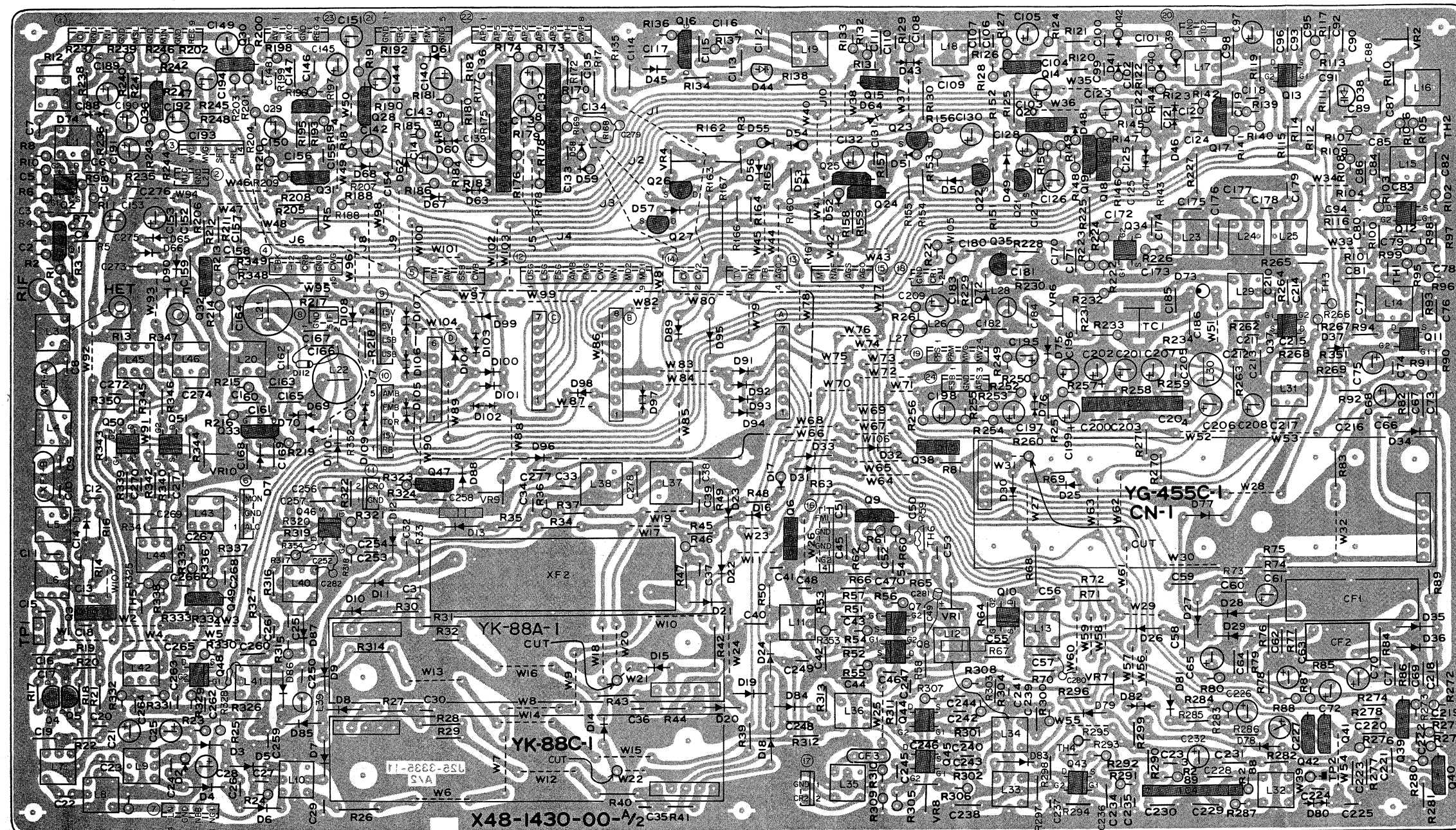




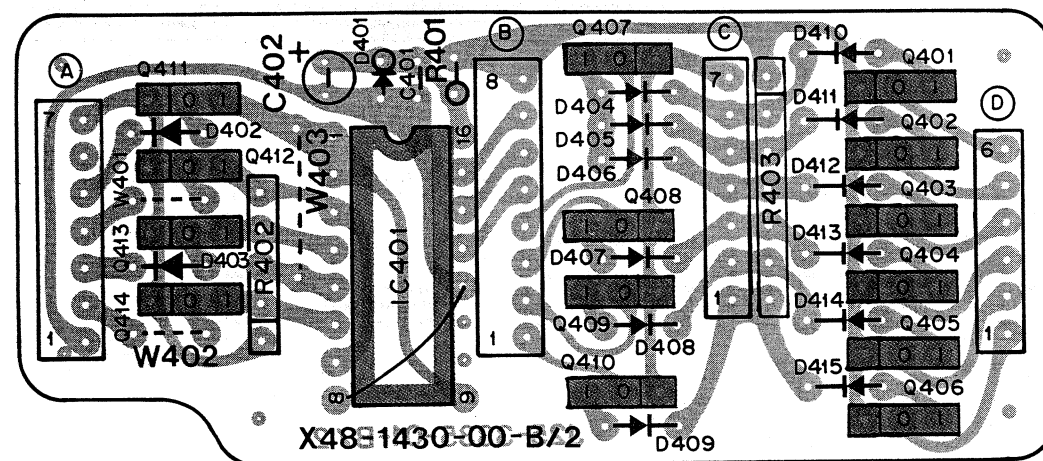
TH 1,2,4,6	:112-103-2
TH 3	:112-503-2
TH 5	:112-501-2
IC401	:SNT4LS145N
IC1,2	:BA718
IC3	:TA7140P
IC4	:TA7302P
Q1	:2SC2668(Y)
Q2,7,8,10-13,34,37,43-45,48,50,51	:3SK73(Y)
Q3,6,18,20,38	:DTC114E5
Q4,5	:2SK125
Q9,49	:2SC2787(L)
Q14,15,17,19,24,28,31,32,39,40,41,47	:2SC2458(Y)
Q16,33	:2SK192A(Gr)
Q21 ~ 23,26,27	:2SK30A(Gr)
Q25,42	:2SA1048(Y)
Q29,30,36	:2SC2459(BL)
Q35	:2SC1959(Y)
Q401-414	:DTA143EF
D14-17,30-33,49,50,52-54,56-59	:1SS133
61,62,64,67,68,70,81,88,89,91-96,98-101,104,106,110,111,402-415	:1SS133
D2	:MTZ6.8J
D3-13,18-24,26-29,34-36,72,77-79,83-87	:1S1587
D25,37	:MTZ3.9J
D38,44	:1SV149A
D39-42	:1N60
D43,60,63,69,76,82,97,105-107	:MC921
D45,66,71	:MTZ10J
D46,47,74,80,109	:MC931
D48,51	:LT8001P
D55	:MTZ6.2JB
D65,90	:MV-203
D73	:WD487R1-3R
D78	:MT24.5J
D102,103	:MC911
D401	:MTZ5.1J(AorB)
D112	:MTZ12JC



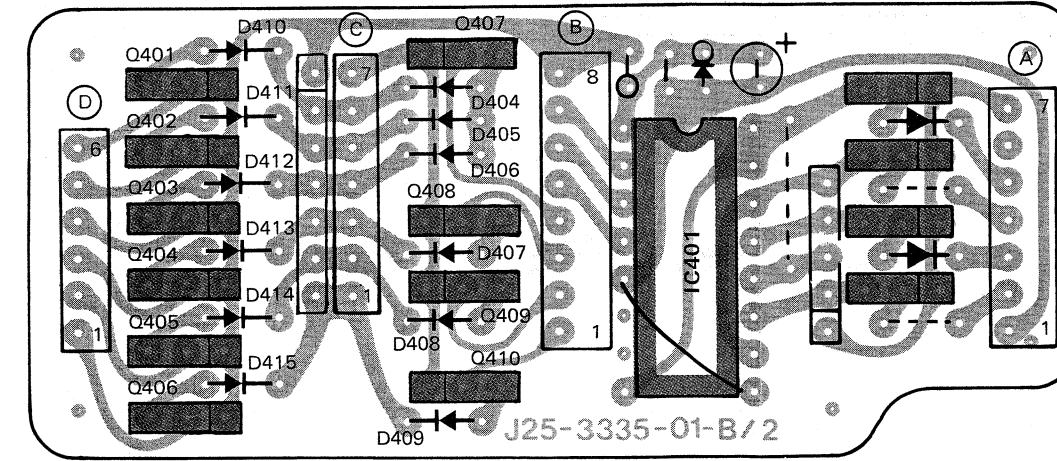
IF UNIT (X48-1430-00) Component side view



Component side view



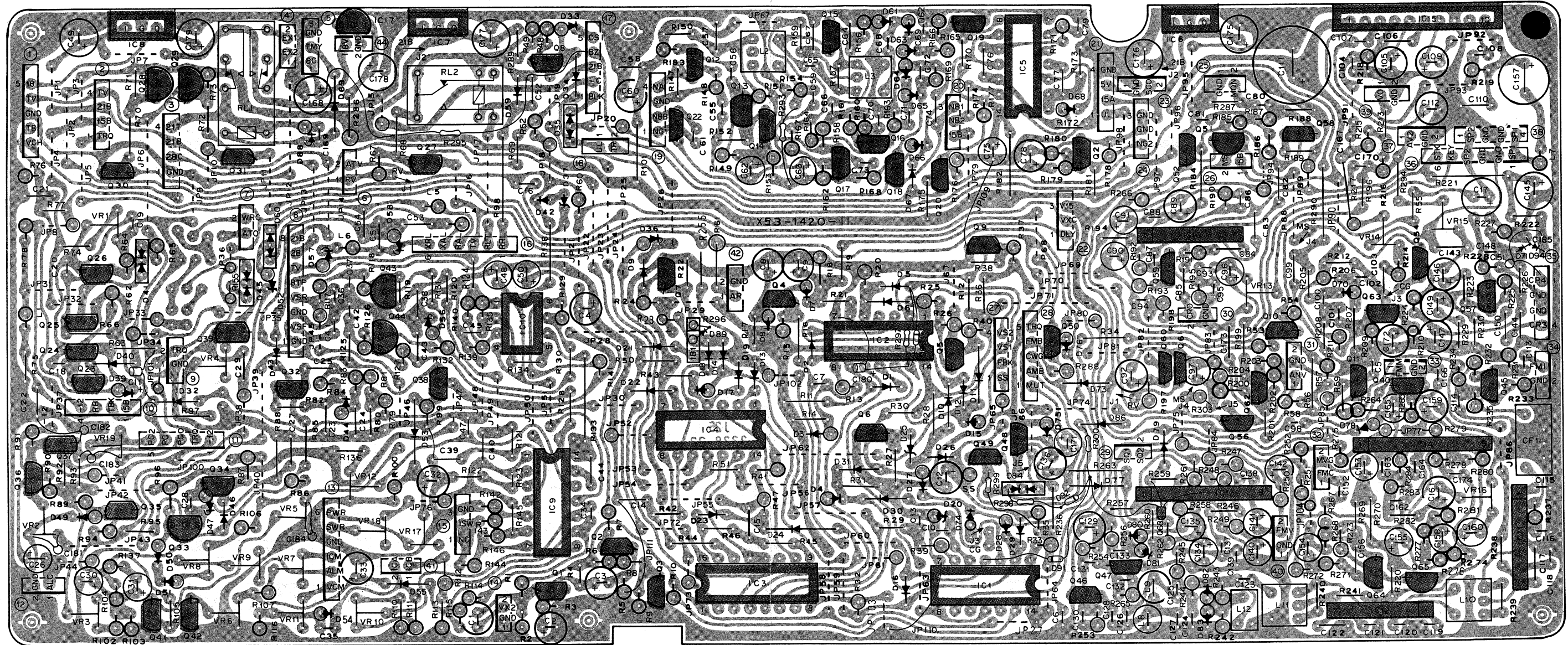
Foil side view



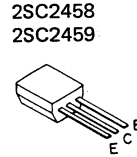


# TS-940S PC BOARD VIEW

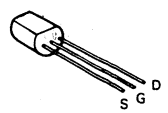
CONTROL UNIT (X53-1420-11) Component side view



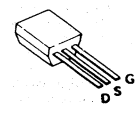
2SA1048  
2SA984K  
2SC2458  
2SC2459



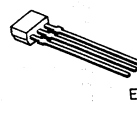
2SK30A



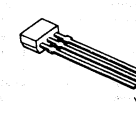
2SK192A



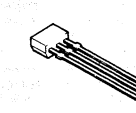
2SC2787



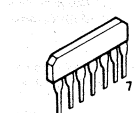
DTA143XS



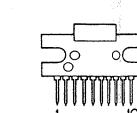
DTC124ES  
DTC144WS



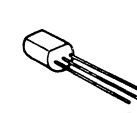
μPC1037H  
μPC577H



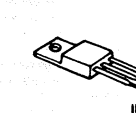
HA1368



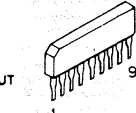
TA78L008AP



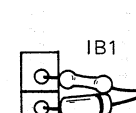
μA7818UC  
μPC7815H



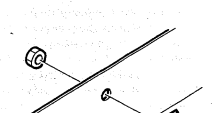
NJM4558S



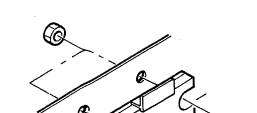
[Attachment method  
of R296, D89]

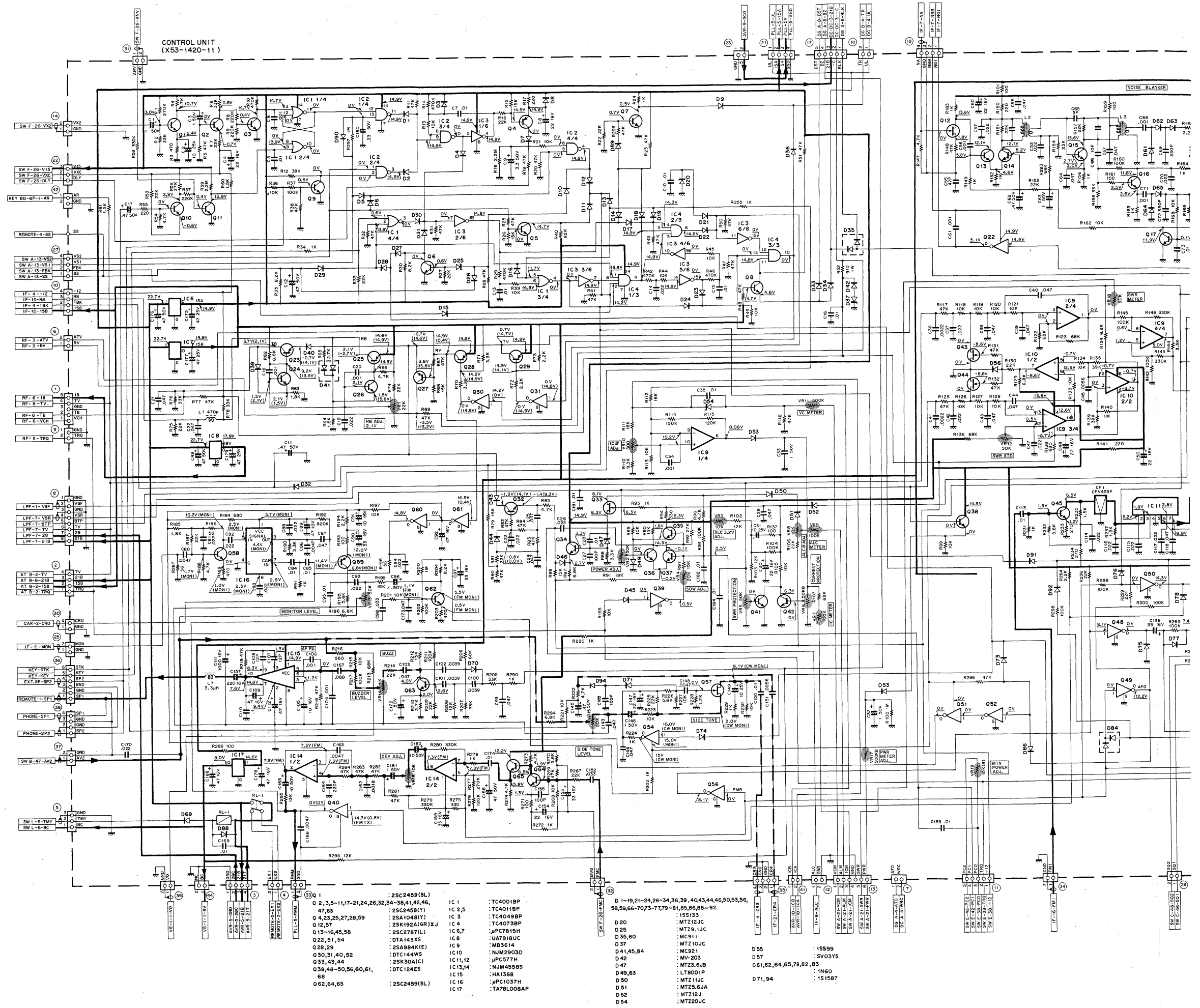


[Attachment method  
of IC6-7]

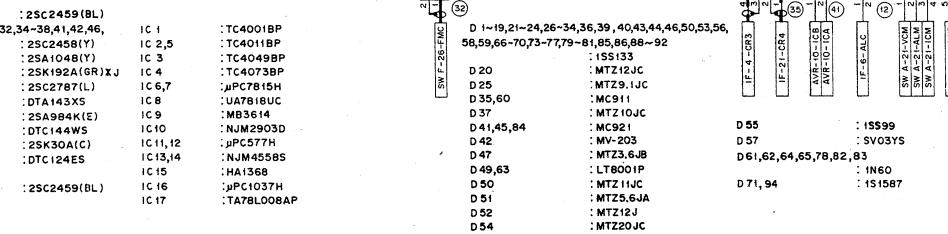


[Attachment method  
of IC15]







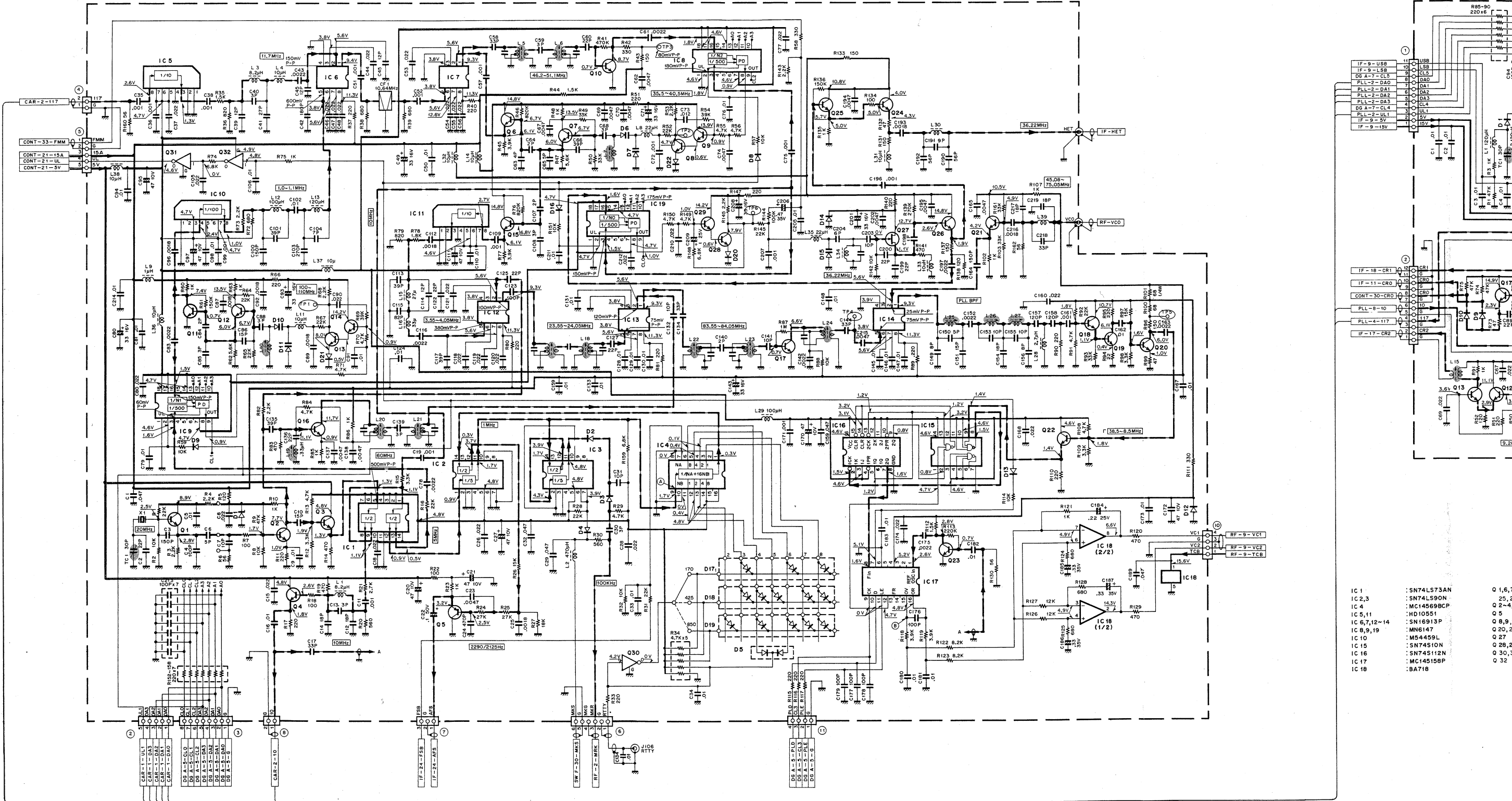




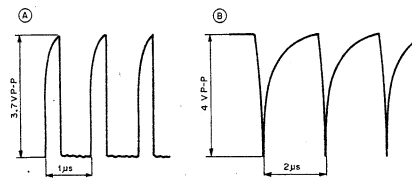
# TS-940S CIRCUIT DIAGRAM

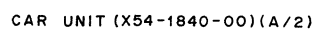
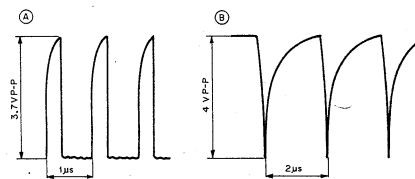
PLL UNIT (X50-2020-00)

CAR UNIT



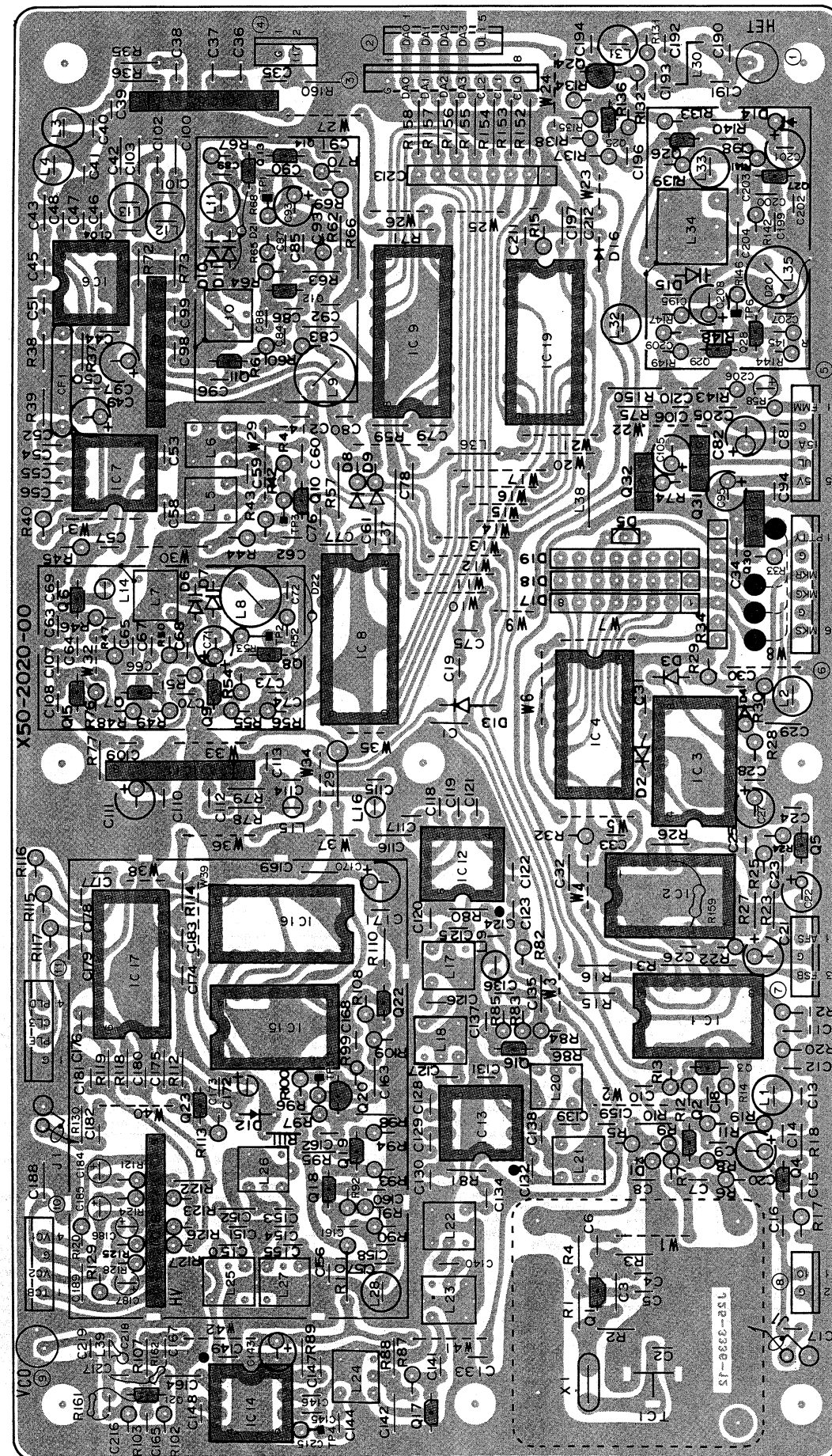
IC 1	:SN74LS73AN	Q 1,6,7
IC 2,3	:SN74LS90N	Q 2,4
IC 4	:MC145696CP	Q 5
IC 5,11	:HD10551	Q 6,9,1
IC 6,7,12-14	:SN16913P	Q 20,2
IC 8,9,19	:MNE6147	Q 27
IC 10	:M54459L	Q 28,2
IC 15	:SN74S10N	Q 30,3
IC 16	:SN74S112N	Q 32
IC 17	:MC145158P	
IC 18	:BA718	



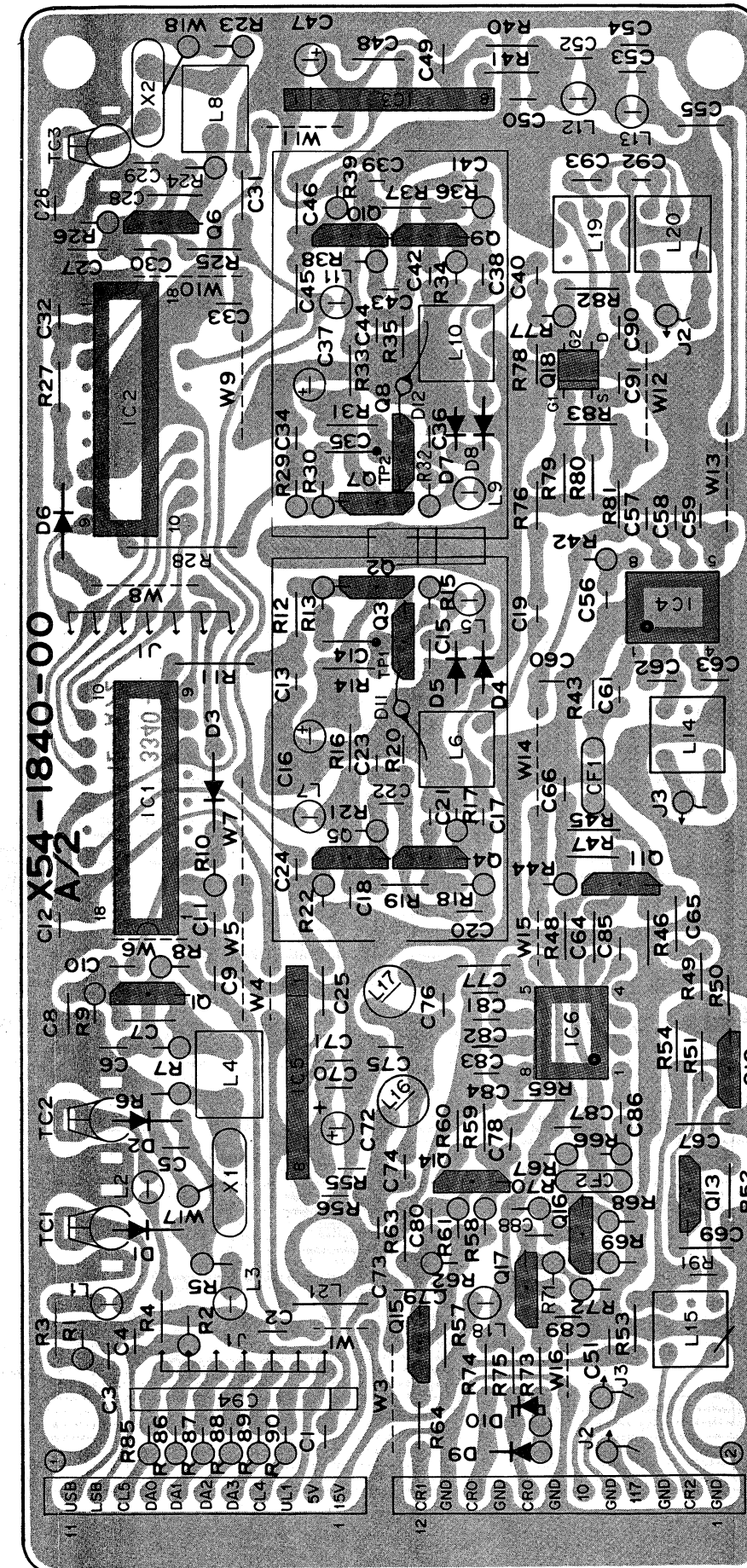




PLL UNIT (X50-2020-00) Component side view



CAR UNIT (X54-1840-00) (A/2) Component side view



# PC BOARD VIEWS TS-940S

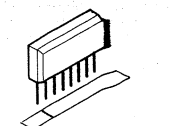
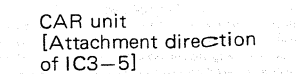
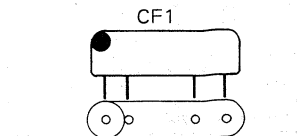
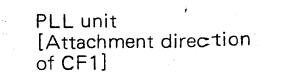
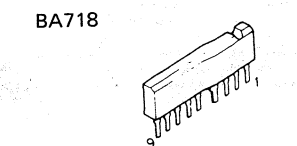
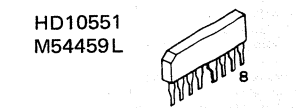
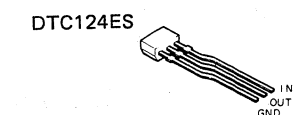
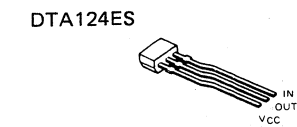
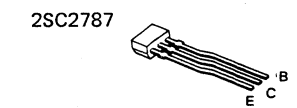
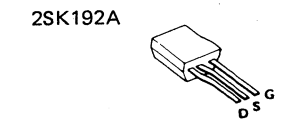
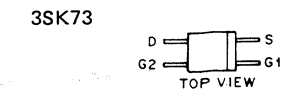
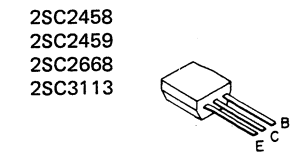
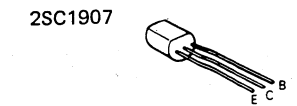
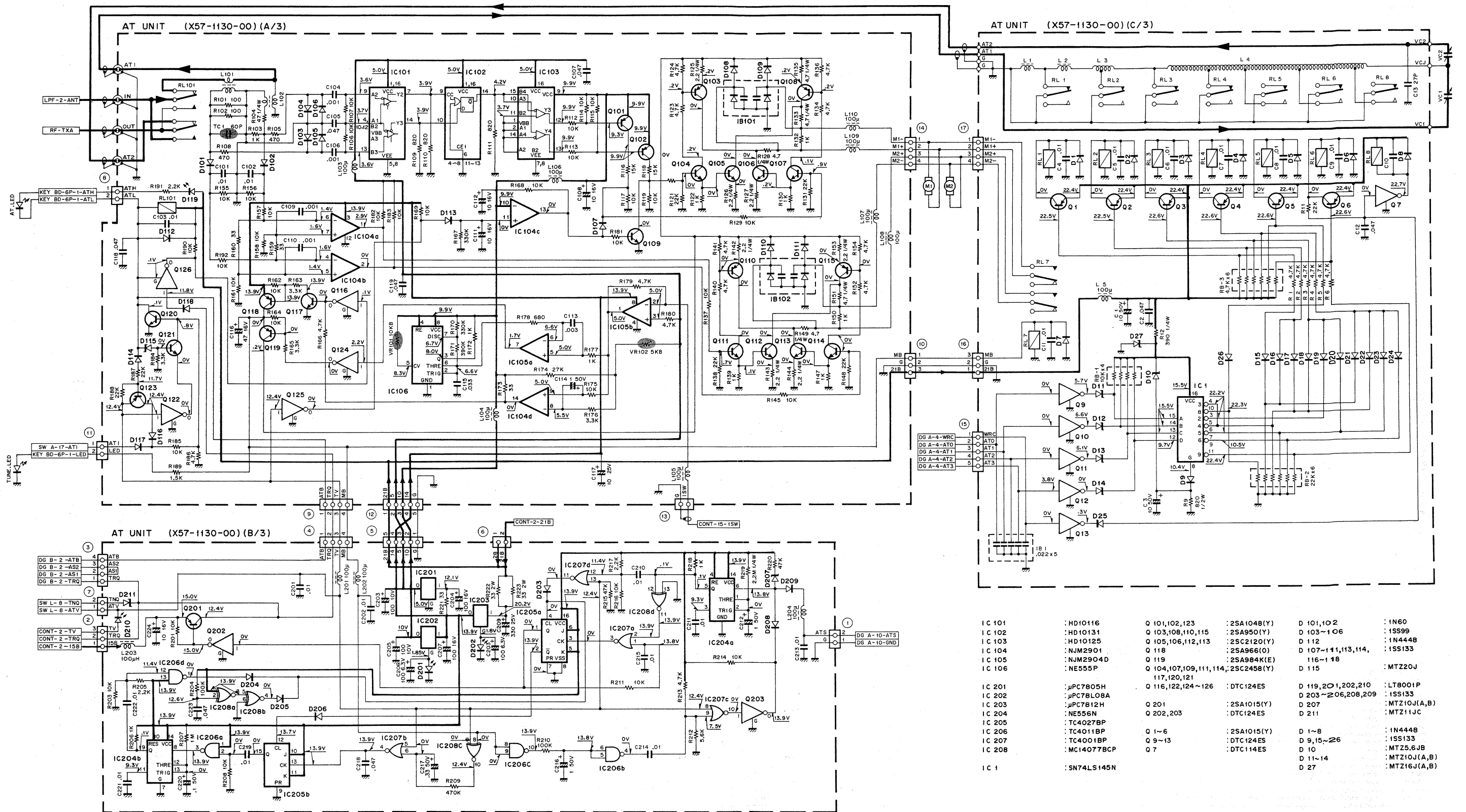




Figure 1 shows a 10-lane agarose gel electrophoresis image. The lanes are labeled A through K. Lane A is a DNA ladder with multiple bands. Lanes B through K show various DNA bands, with lane K being a control lane with a single band at the bottom.



# CIRCUIT DIAGRAM TS-940S



2SA1015  
2SA950  
2SA966  
2SA984K  
2SC2120

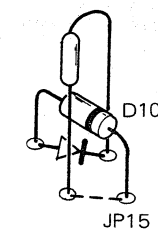
2SA1048  
2SC2458

DTC114ES  
DTC124ES

μPC78L08A

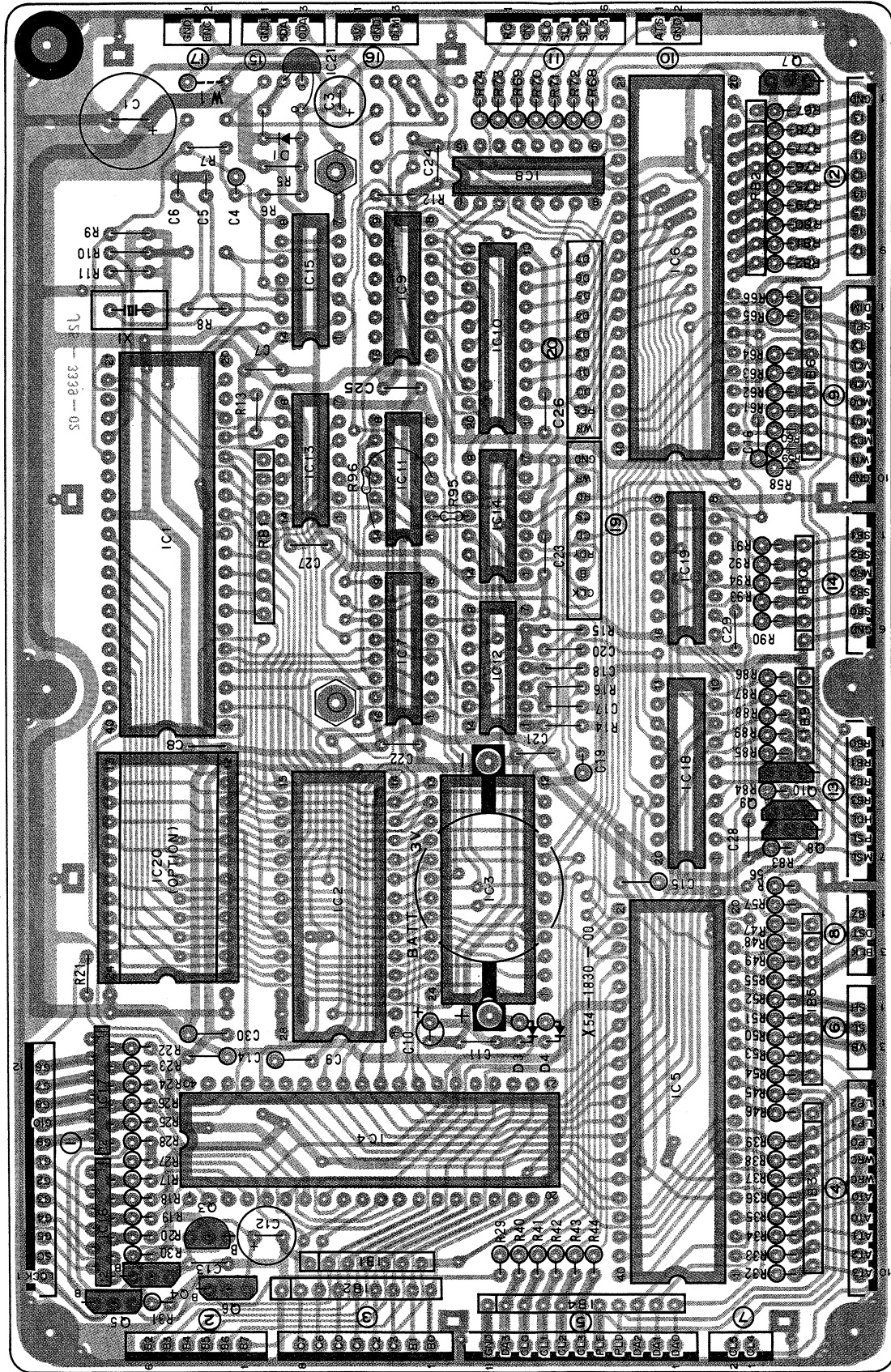
μPC7805H  
μPC7812H

[Attachment method  
of JP15, D10]

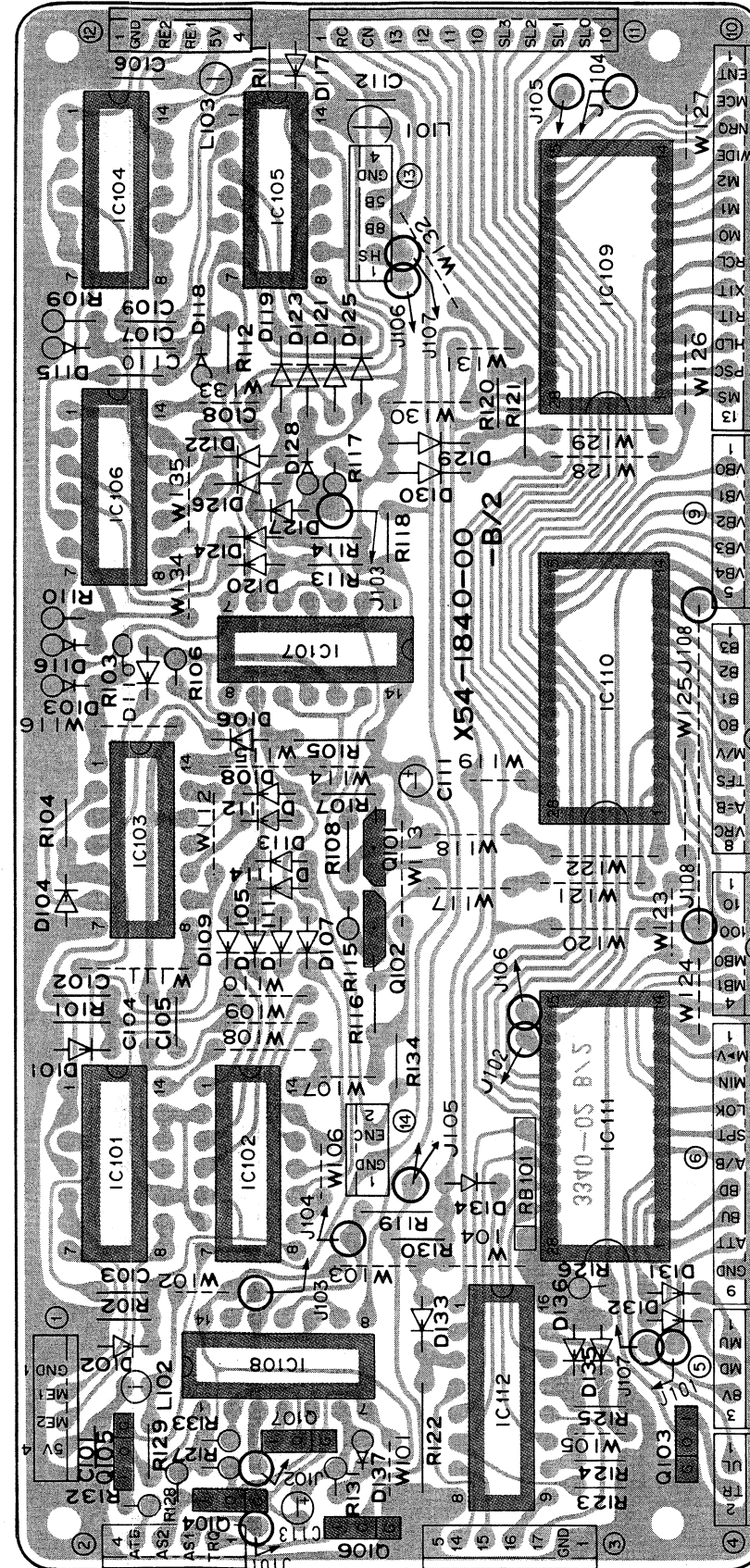


# TS-940S PC BOARD VIEWS

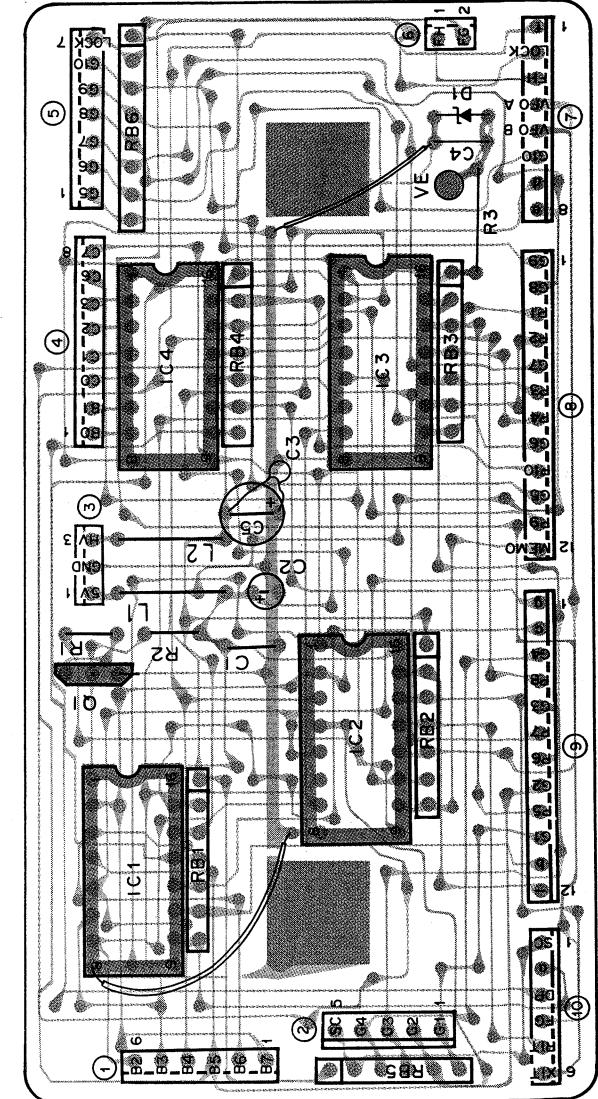
DIGITAL A UNIT (X54-1830-00) Component side view



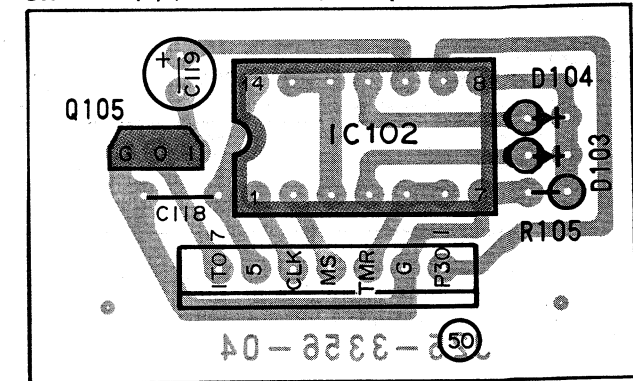
DIGITAL B UNIT (X54-1840-00) (B/2) Component side view



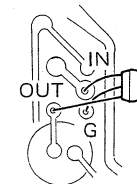
DIGITAL C UNIT (X54-1850-00) Component side view



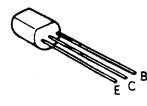
SW UNIT (P) (J25-3356-04) Component side view



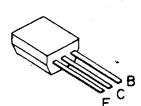
DIGITAL A unit  
[Attachment direction  
of IC21]



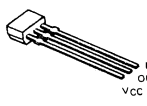
2SC1959



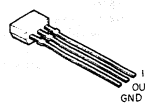
2SA1049  
2SC2458



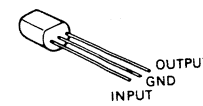
DTA114ES  
DTA124ES



DTC114ES  
DTC124ES  
DTC144ES

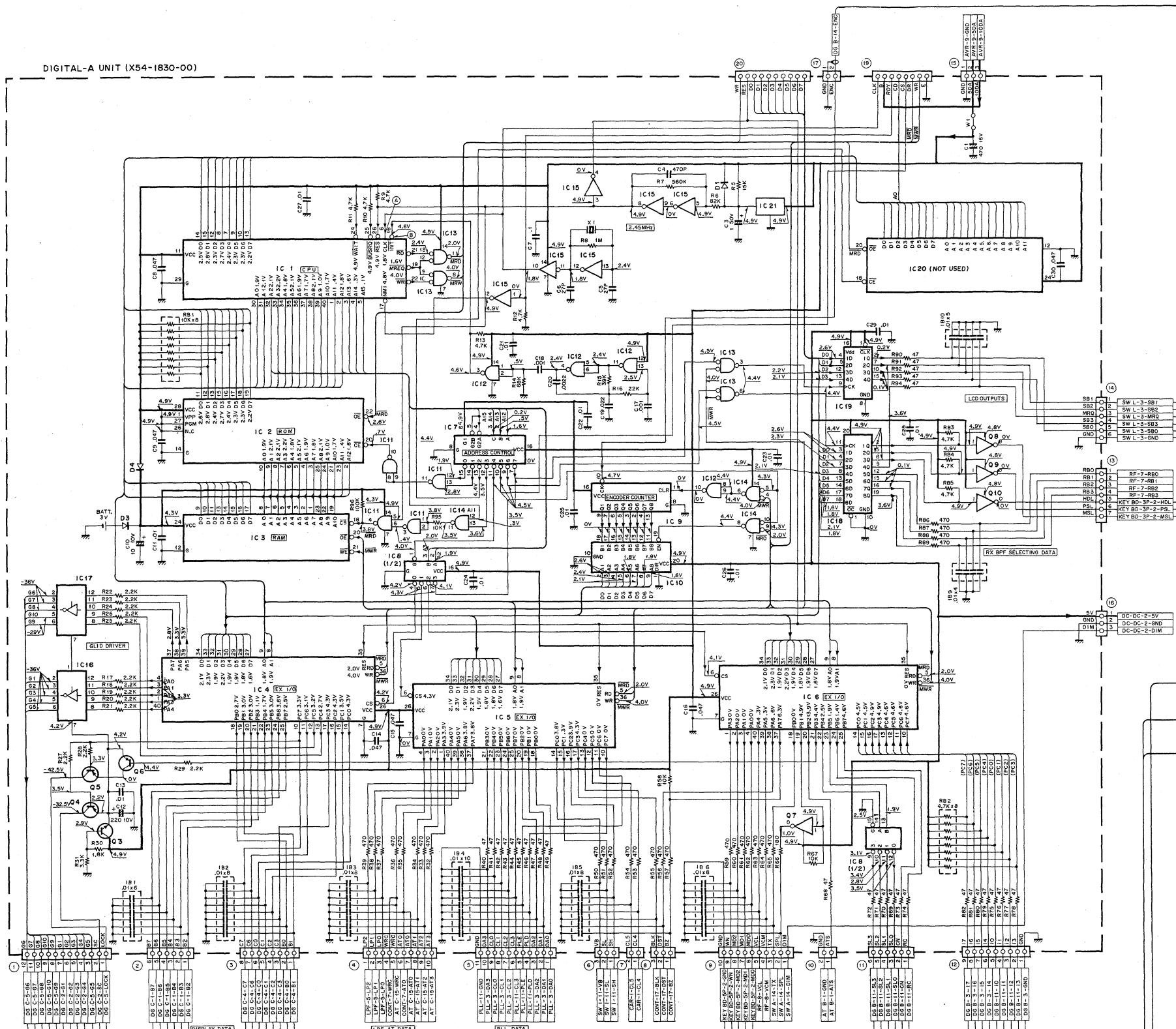


PST518A





# DIGITAL-A UNIT (X54-1830-00)



- IC 1 : LH0080A
- IC 2 : MM2764-30T2
- IC 3 : MB8416-20LP-GRA
- IC 4,5,6 : PD8255AC-5
- IC 7 : HD74LS138P
- IC 8 : SN74LS139N
- IC 9 : TC40108B
- IC 10 : HD74LS245WP
- IC 11,12 : TC4011BP
- IC 13,14 : M74LS32P
- IC 15 : TC40H004P
- IC 16,17 : T457
- IC 18 : SN74LS374N
- IC 19 : SN74LS175N
- IC 21 : PST518A
- IC 20 : NOT USED

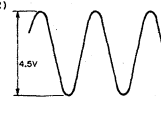
Q 3 : 2SC1959(Y)

Q 4,5,6 : 2SA1049(GR)

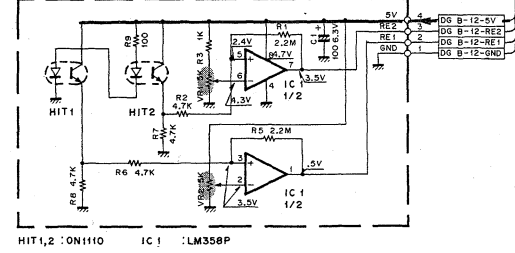
Q 7 : DTA124ES

Q 8,9,10 : DTA114ES

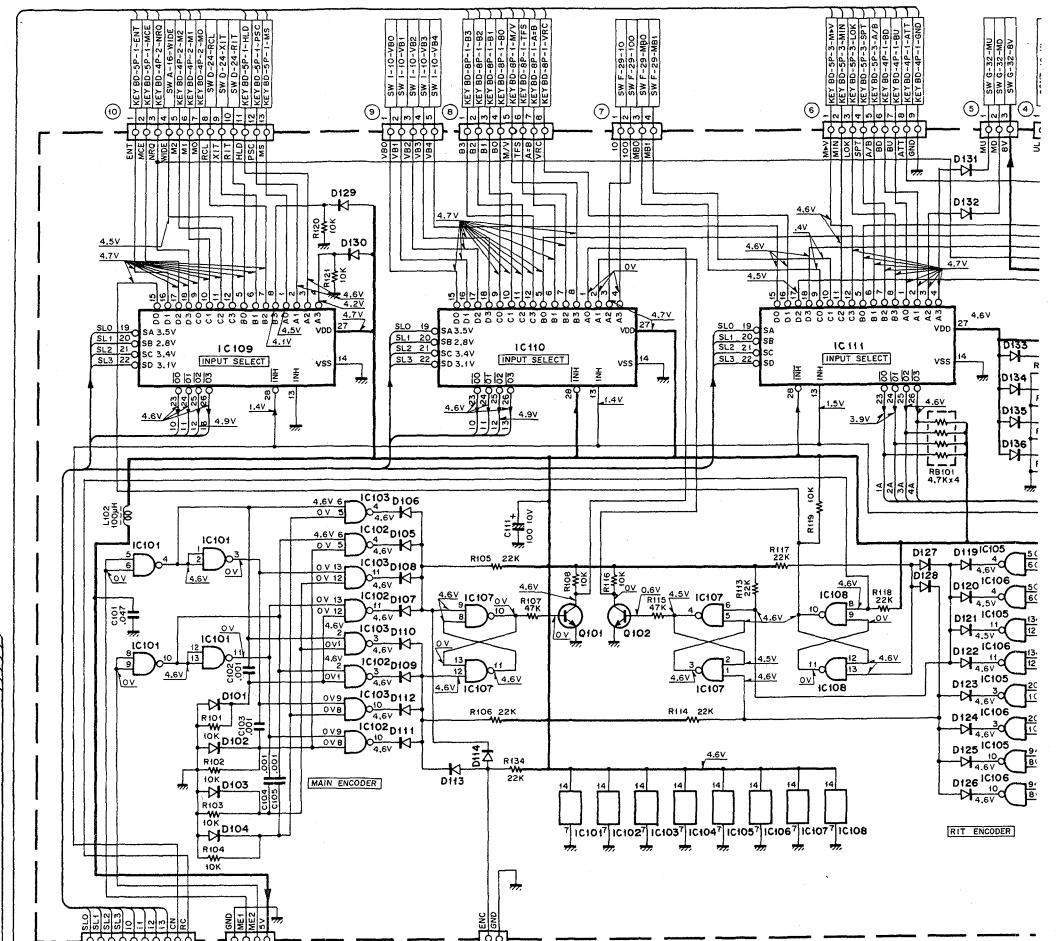
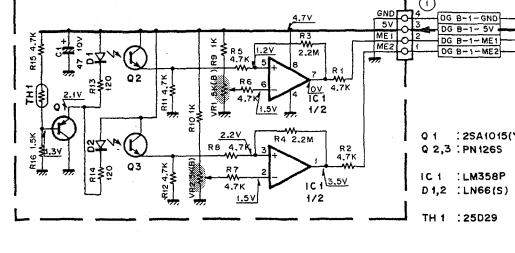
D 1,2,3,4 : 1SS133



## RIT ENCODER UNIT (X54-1690-01)

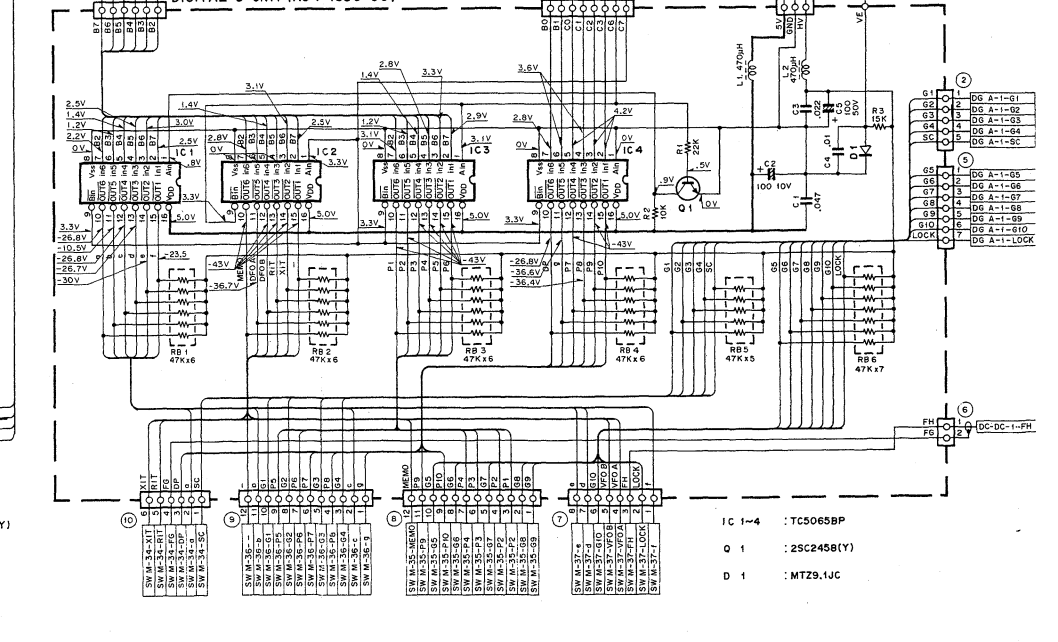


## MAIN ENCODER ASSY (W02-0328-10)

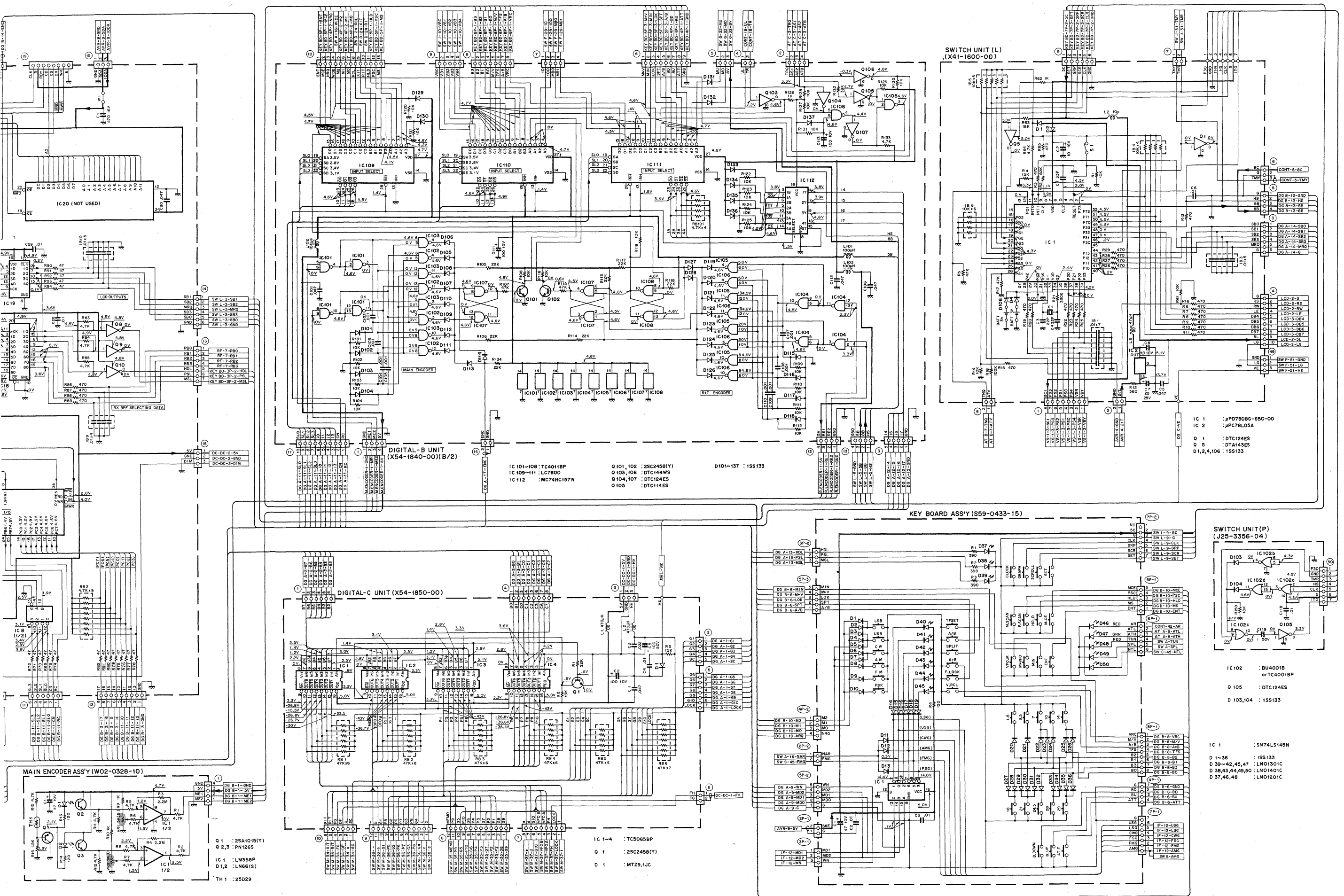


- IC 101-108 : TC4011BP
- IC 109-111 : LC7800
- IC 112 : MC74HC157N
- Q101,102 : 2SC2458(Y)
- Q103,106 : DTC144WS
- Q104,107 : DTC124ES
- Q105 : DTC114ES
- D101-137

## DIGITAL-C UNIT (X54-1850-00)



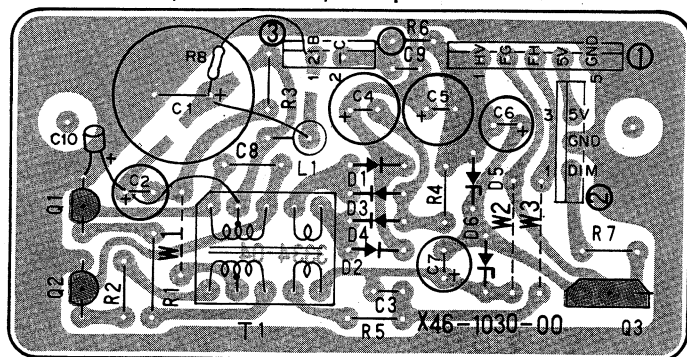
- IC 1-4 : TC5065BP
- Q 1 : 2SC2458(Y)
- D 1 : MTZ9.1UC



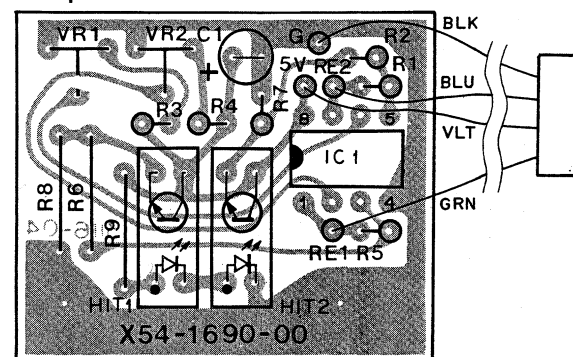


# TS-940S PC BOARD VIEWS

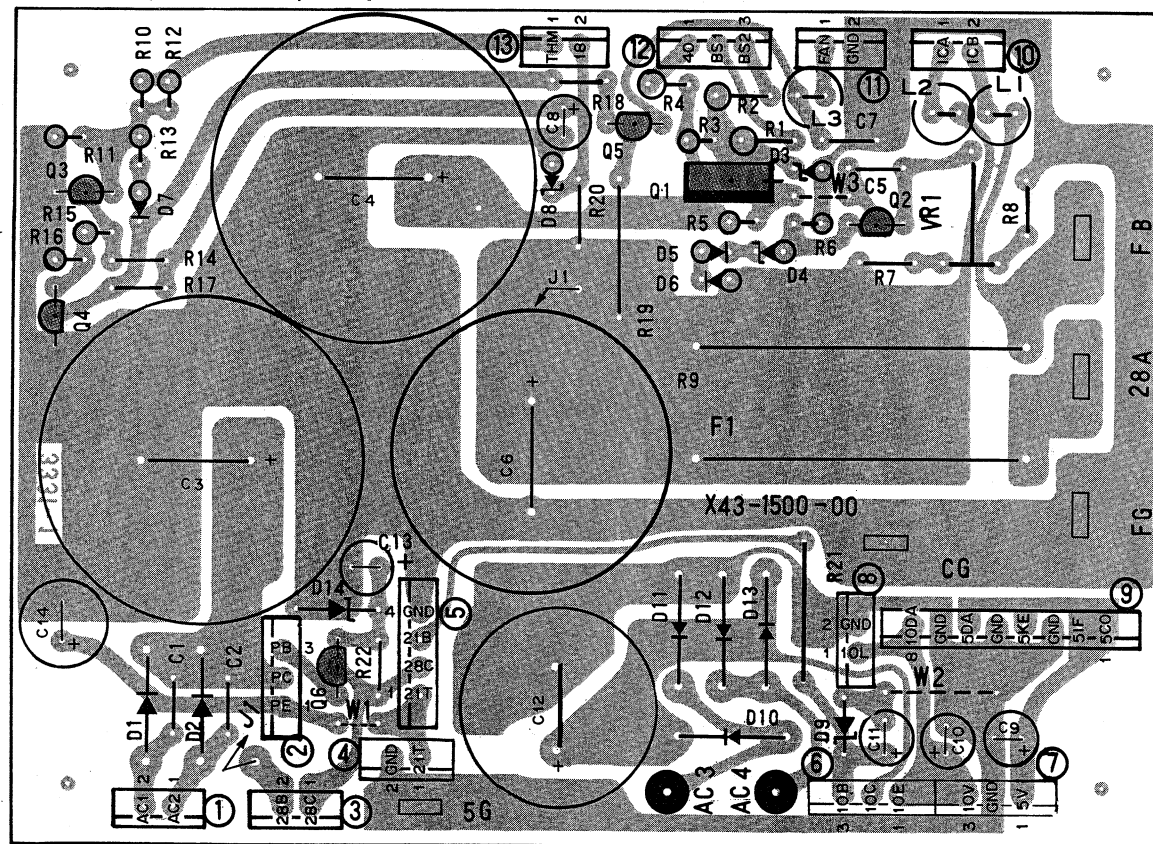
DC-DC UNIT (X46-1030-00) Component side view



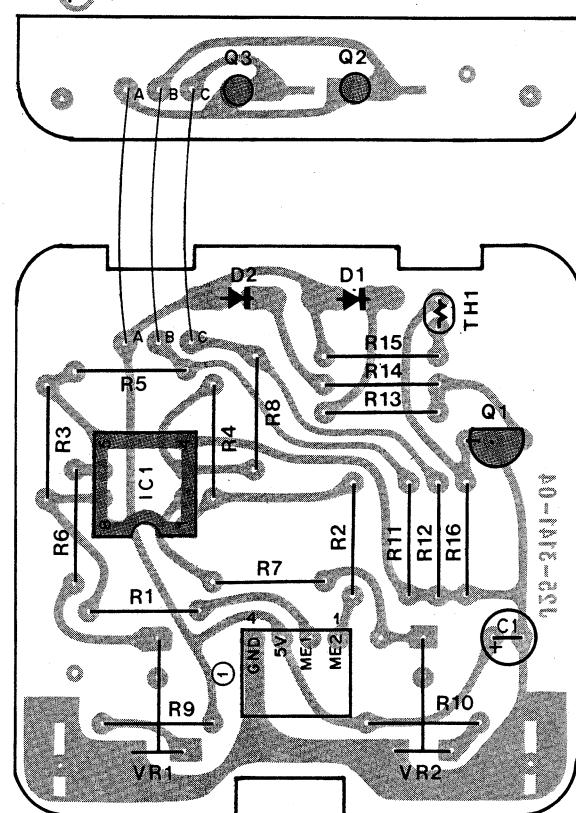
RIT ENCODER UNIT (X54-1690-01) Component side view



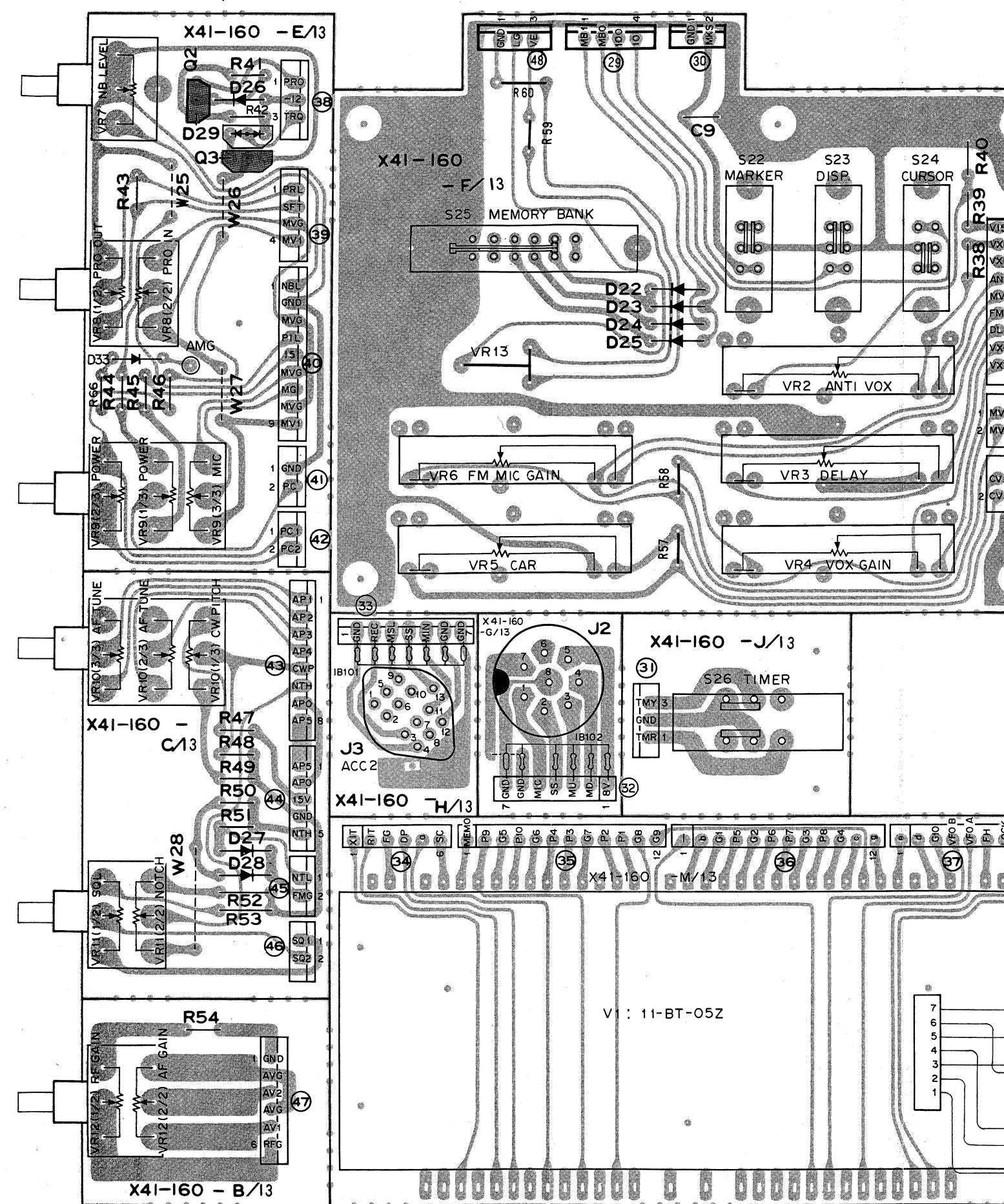
AVR UNIT (X43-1500-00) Component side view



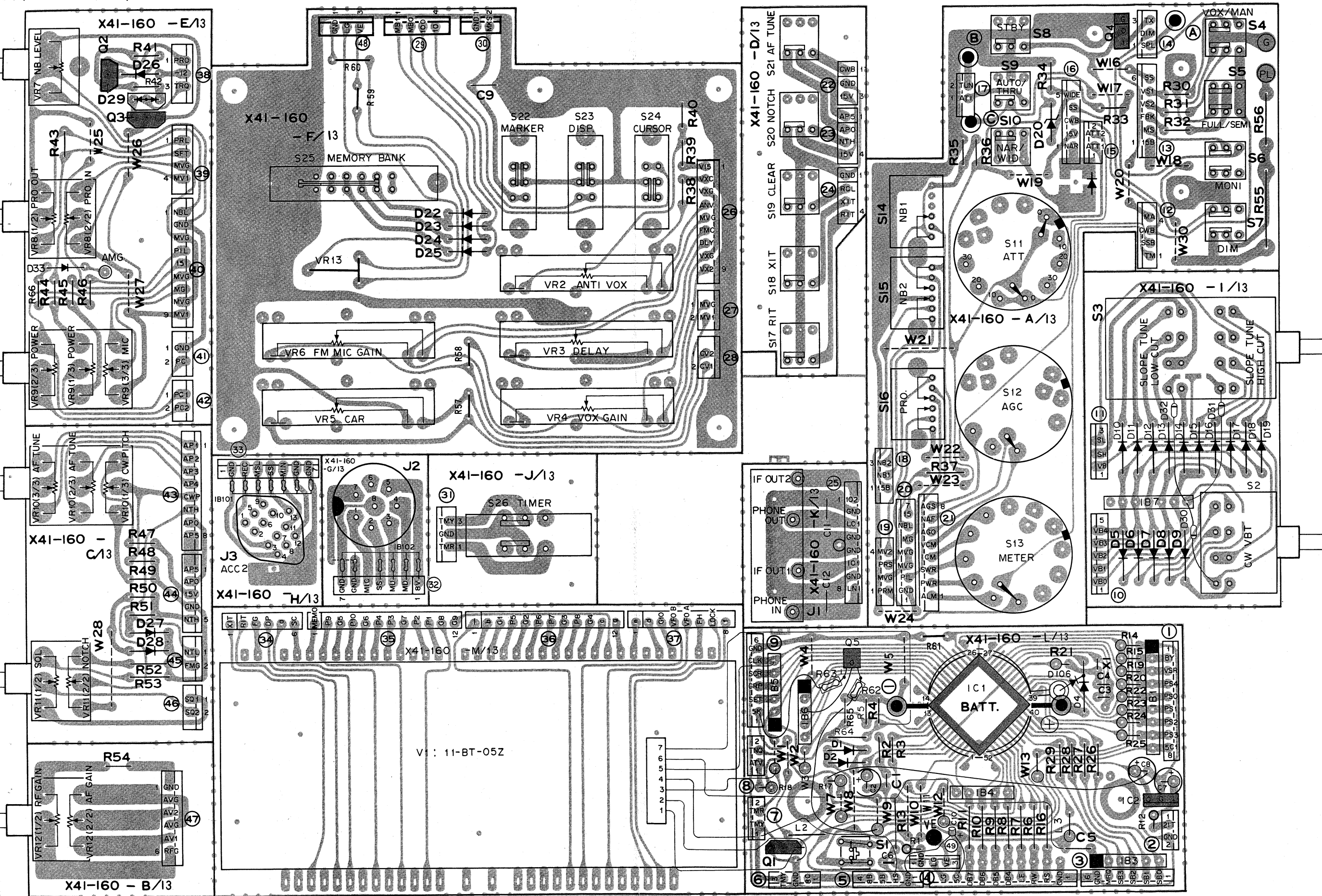
MAIN ENCODER ASS'Y (W02-0328-10) Component side view



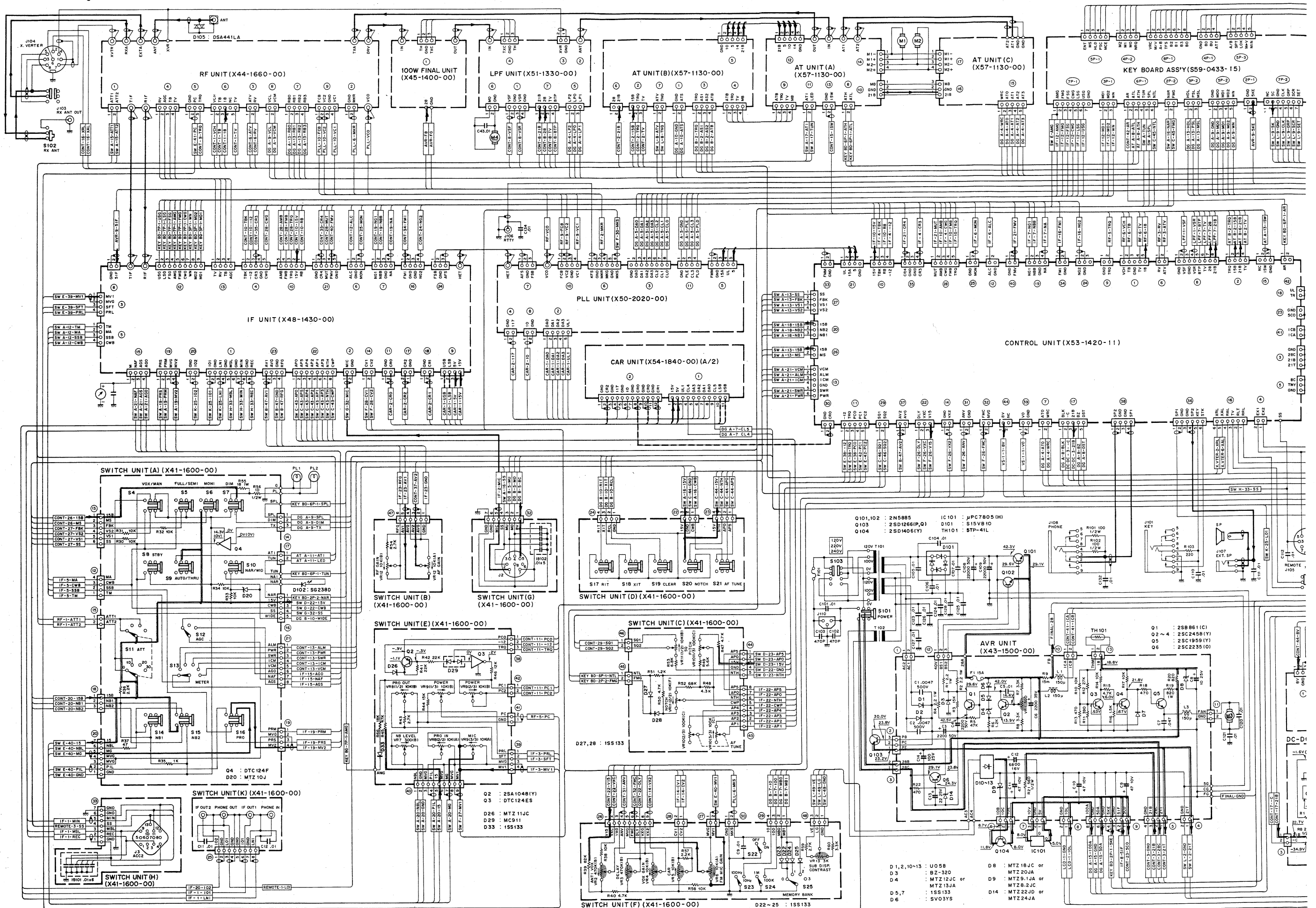
SW UNIT (X41-1600-00) Component side view







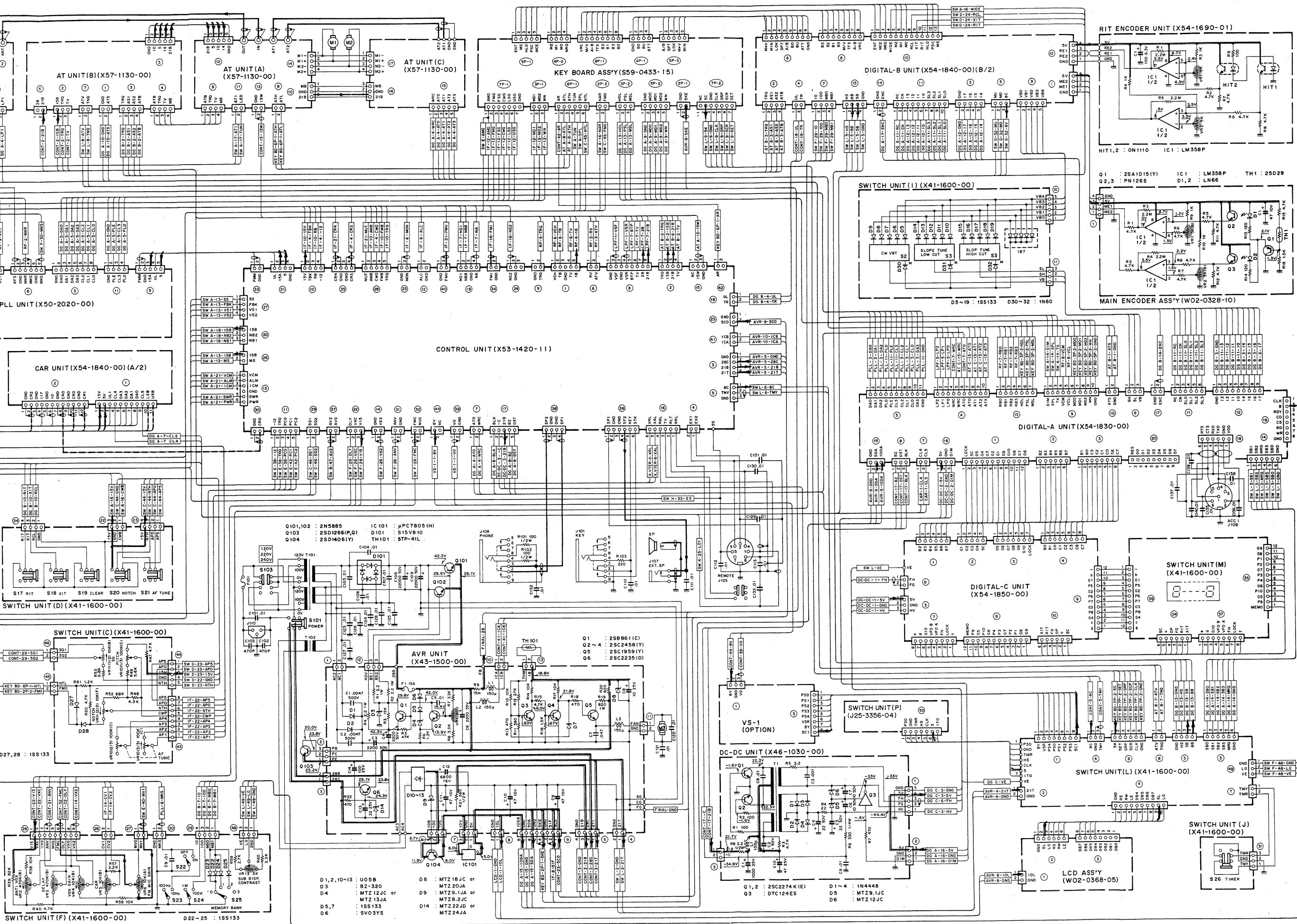
Signal line      Control line      Common DC line      Voltage measurement conditions f=14.150MHz, RX no signal, ( ) : TX.





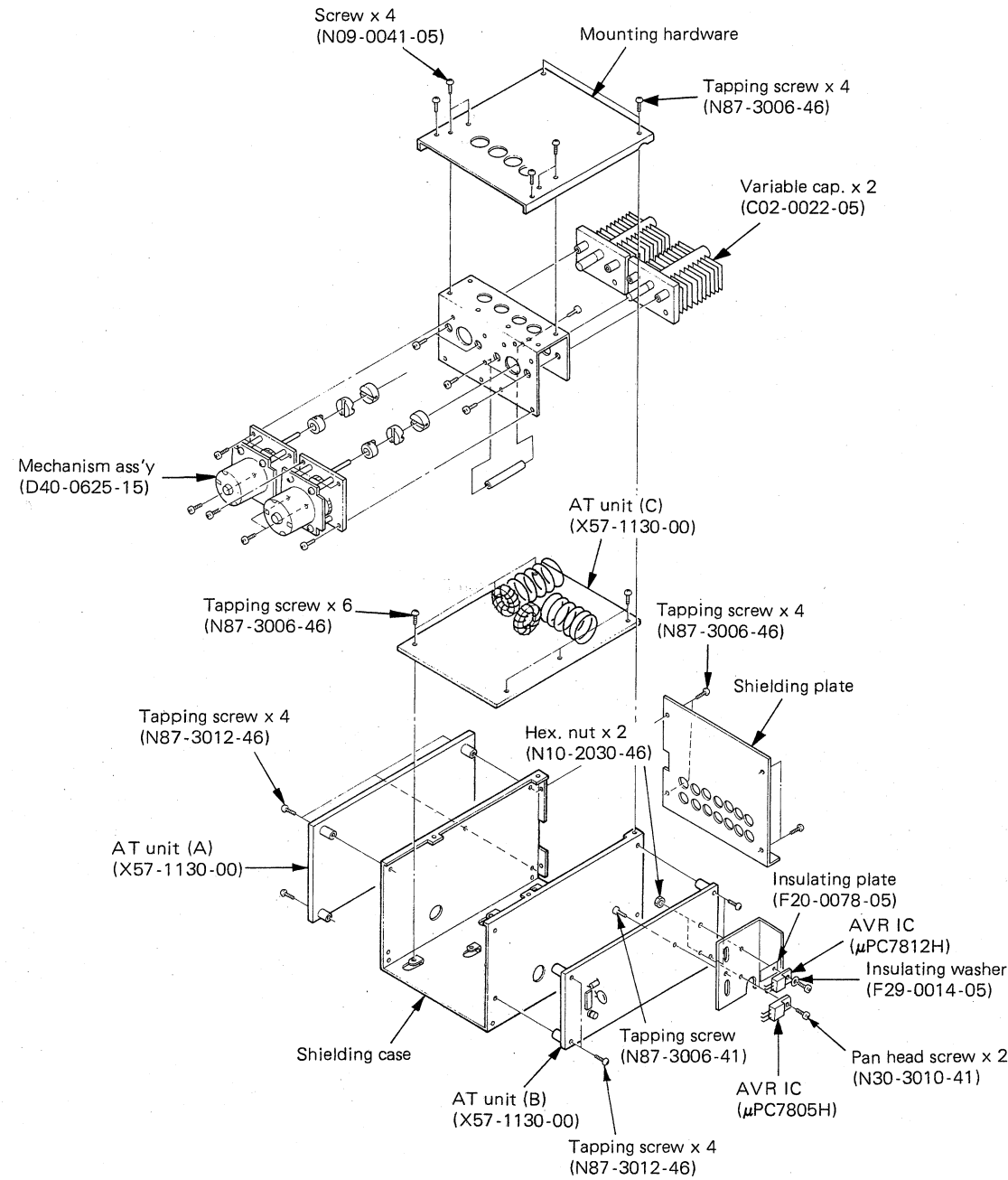
Conditions f=14.150MHz, RX no signal, ( ) : TX.

# SCHEMATIC DIAGRAM TS-940S



AT-940 (ANTENNA TUNER)

DISASSEMBLY

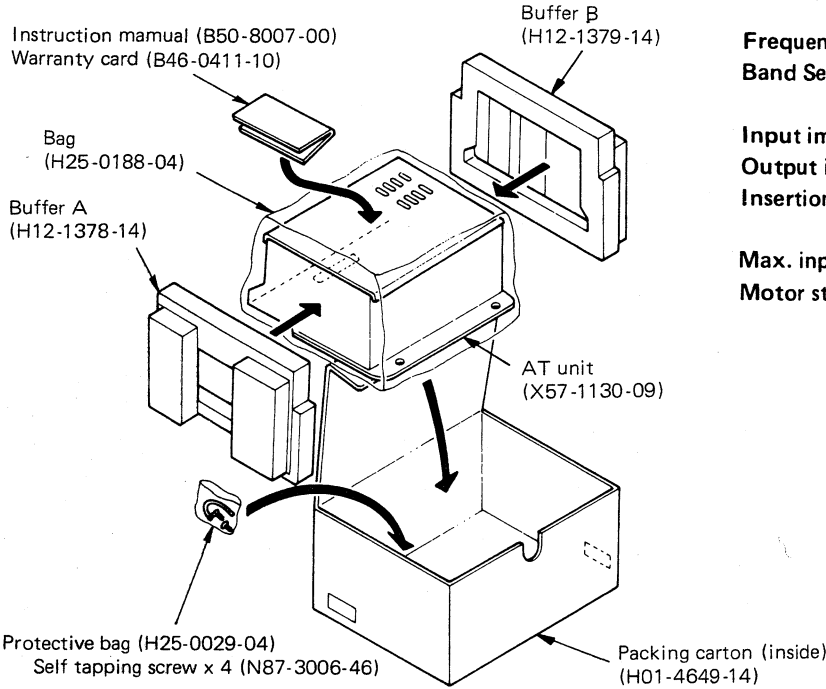


PARTS LIST

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
B46-0415-00	*	WARRANTY CARD	K	1
B50-8007-00	N	INSTRUCTION MANUAL	1	1
H01-4649-14	N	CARTON (INSIDE)	1	
H12-1378-14	N	BUFFER (A)	1	
H12-1379-14	N	BUFFER (B)	1	
H25-0029-04		BAG	1	
H25-0103-04		BAG	2	
H25-0188-04		BAG	1	
N87-3006-46		TAPPING SCREW M3X6	4	
N87-3012-46		TAPPING SCREW M3X12	8	
X57-1130-09	N*	AT UNIT	1	

AT-940 (ANTENNA TUNER)/SO-1 (STANDARD OSCILLATOR UNIT)

AT-940 PACKING



AT-940 SPECIFICATIONS

Frequency range:	1.8—29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20—150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

SPECIF

Speaker u:  
Rated Inp  
Impedanc  
Frequency  
Filter c  
LOV  
HIG  
HIG  
HIG  
Filter a  
Dimension

Net weigh  
Accessorie

PARTS

SO-1 SPECIFICATIONS

Oscillating frequency . . . . . 20MHz  
Frequency stability (long period) . . . . .  $\pm 1 \times 10^{-6}$ /Year  
Temperature stability . . . . .  $\pm 5 \times 10^{-7}$  (−10°C ~ +50°C)  
Adjustable frequency range . . . . . More than  $\pm 60$ Hz  
Output . . . . . More than 0dBm at 50Ω  
Weight . . . . . 25g


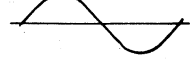
SO-1 PARTS LIST

N : New parts

Parts No.	Re- marks	Description	Ref. No.
B50-3992-00	N	Instruction manual	
H25-0029-04		Protective bag	

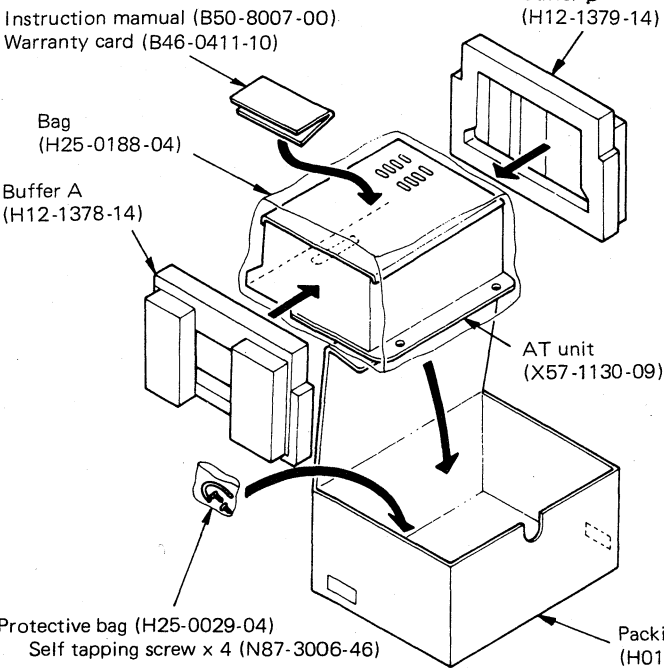
SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than  $2 \times 10^{-8}$ /day  
The f-counter must be preheated enough before use.

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Reference frequency oscillator	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter  Oscilloscope SP	Rear panel	ANT  EXT.SP	SO-1 (PLL)	Potentiometer	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave  NG   OK 

AT-940 (ANTENNA TUNER)/SO-1 (STANDARD OSCILLATOR UNIT)

AT-940 PACKING



AT-940 SPECIFICATIONS

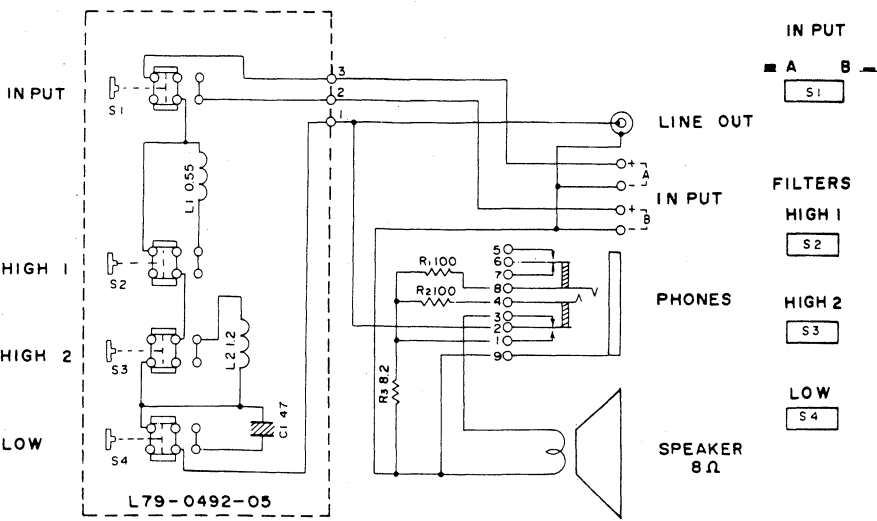
- Frequency range: 1.8–29.7 MHz, all amateur bands
- Band Selection: Automatic, by band information from the transceiver.
- Input impedance: 50 ohms, unbalanced
- Output impedance: 20–150 ohms, unbalanced
- Insertion loss: Less than 1 dB at 29.7 MHz (at best match)
- Max. input power: 150W
- Motor stop SWR: Less than 1.2

SP-940 (SPEAKER)

SPECIFICATIONS

- Speaker used: 10 cm dia.
- Rated Input: 1.5 Watts
- Impedance: 8Ω
- Frequency response: 160 Hz to 8kHz.
- Filter cut-off frequency,
  - LOW: 430Hz, –3dB.
  - HIGH 1: 2.3 kHz, –3dB.
  - HIGH 2: 1.0kHz, –3dB.
  - HIGH 1 + HIGH 2: 730Hz, –3dB.
- Filter attenuation: –6dB/oct.
- Dimensions:
  - W 180 mm (7-1/16")
  - H 140 mm (5-1/2")
  - D 288 mm (11-1/3")
- Net weight: 1.9 kg. (4.2 lbs.)
- Accessories furnished: Speaker cord, 1pc. (E14-0101-05) 1 pin plug, 2 pcs. (E20-1610-05)

SCHEMATIC DIAGRAM



SO-1 SPECIFICATIONS

- Oscillating frequency . . . . . 20MHz
- Frequency stability (long period) . . . . .  $\pm 1 \times 10^{-6}$ /Year
- Temperature stability . . . . .  $\pm 5 \times 10^{-7}$  (–10°C ~ +50°C)
- Adjustable frequency range . . . . . More than  $\pm 60$ Hz
- Output . . . . . More than 0dBm at 50Ω
- Weight . . . . . 25g


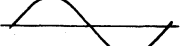
SO-1 PARTS LIST

N : New parts

Parts No.	Re- marks	Description	Ref. No.
B50-3992-00	N	Instruction manual	
H25-0029-04		Protective bag	

SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than  $2 \times 10^{-8}$ /day  
The f-counter must be preheated enough before use.

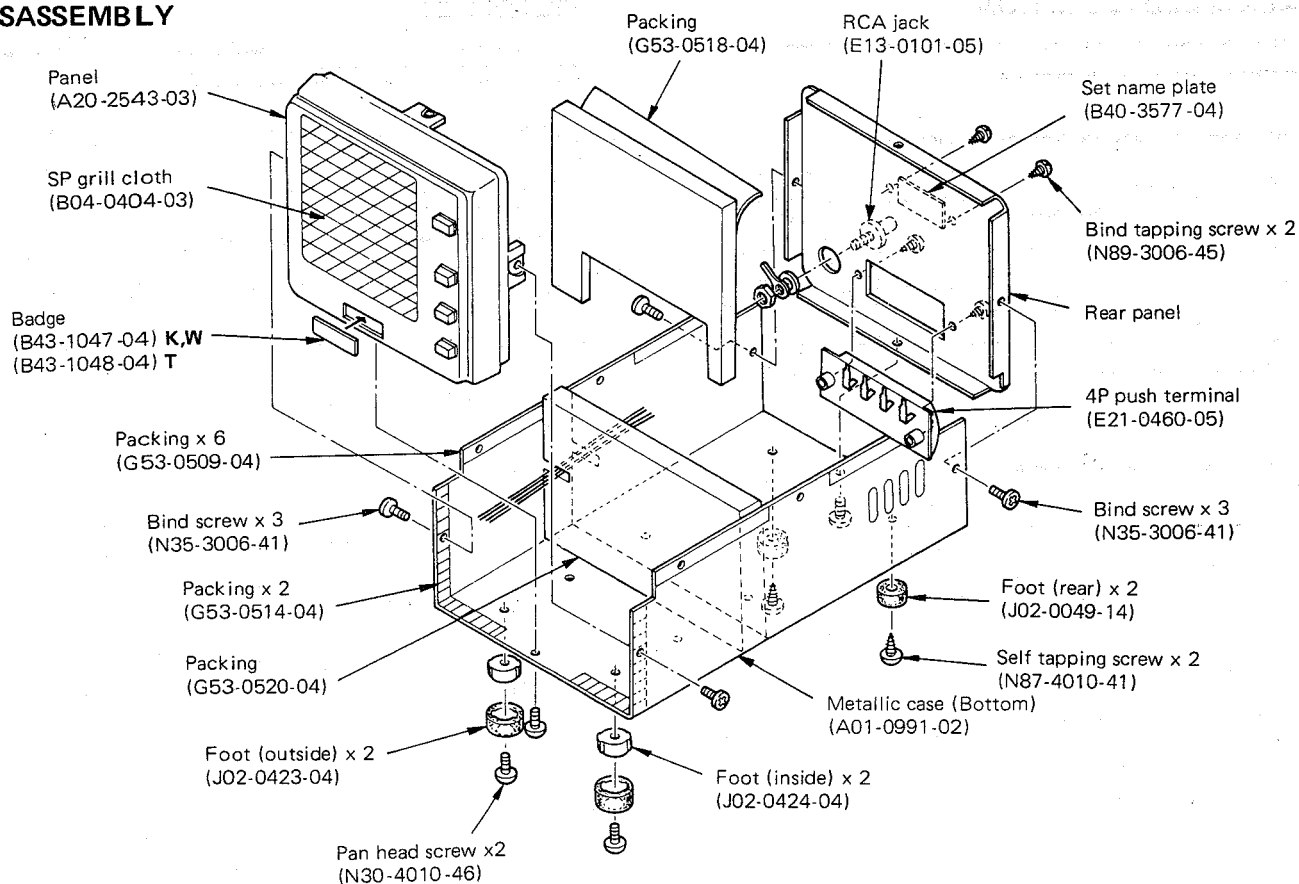
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Reference frequency oscillator	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter  Osillo- scope SP	Rear panel	ANT  EXT.SP	SO-1 (PLL)	Poten- tiome- ter	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave  NG   OK 

PARTS LIST

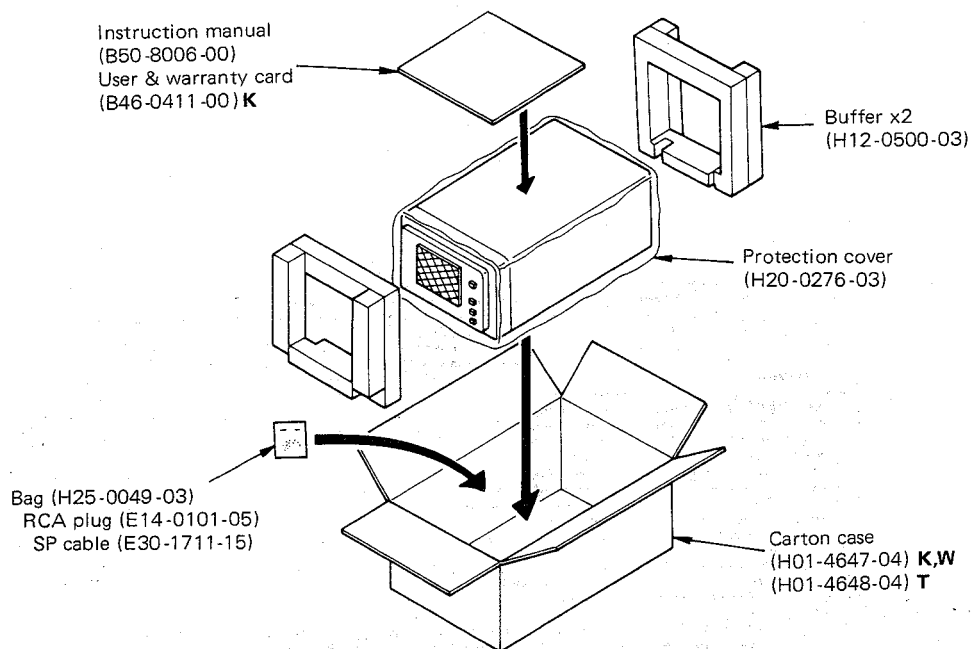
PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
A01-0990-03	N*	METALLIC CASE UPPER	1	
A01-0991-02	N*	METALLIC CASE BOTTOM	1	
A20-2543-03	N*	PANEL	1	
B04-0404-03		SP GRILE	1	
B40-3577-04	N*	MODEL NAME PLATE	1	
B43-1047-04	N*	BADGE KENWOOD K, W	1	
B43-1048-04	N*	BADGE TRIO T	1	
B46-0411-00	*	WARRANTY CARD K	1	
B50-8006-00	N	INSTRUCTION MANUAL	1	
CE04BW1E470M		ELECTRO NONPOLE 47 25V	1	C 1
E11-0404-05		PHONE JACK	1	
E13-0101-05		RCA JACK LINE OUT	1	
E14-0101-05		RCA PLUG 1P	1	
E21-0460-05	N	PUSH TERMINAL 4P	1	
E30-1711-15	N	SP CABLE	1	
E40-0373-05		MINI CONNECTOR 3P	1	
G53-0509-04		PACKING	6	
G53-0514-04		PACKING	2	
G53-0517-04	N	PACKING	8	
G53-0518-04	N	PACKING	1	
G53-0520-04	N	PACKING	1	
H01-4647-04		CARTON CASE K, W	1	
H01-4648-04		CARTON CASE T	1	
H12-0500-03		BUFFER	2	
H20-0276-03		PROTECTION COVER	1	
H25-0049-03		BAG	1	
J02-0049-14		FOOT REAR	2	
J02-0423-04		FOOT FRONT(OUT SIDE)	2	
J02-0424-04		FOOT FRONT( IN SIDE)	2	
J61-0019-05		VINYL TIE	3	
K29-0757-04		PUSH KNOB INPUT A/B	1	
K29-0758-04		PUSH KNOB FILTER	3	
L79-0492-05		FILTER	1	
N30-4010-46		PAN HD SCREW M4X10	2	
N35-3006-41		BIND SCREW M3X6	14	
N87-3008-41		TAPPING SCREW M3X8	4	
N87-4008-46		TAPPING SCREW M4X8	4	
N87-4010-41		TAPPING SCREW M4X10	2	
N89-3006-45		BIND TAPPING SCREW M3X6	2	
N89-3008-45		BIND TAPPING SCREW M3X8	2	
RS14AB3D8R2J		METAL FILM 8.2 OHM 2W	1	R 3
S40-2436-05		PUSH SWITCH	1	
S42-3405-05		PUSH SWITCH	1	
T07-0222-05		SPEAKER	1	

## SP-940 (SPEAKER)

### DISASSEMBLY



### PACKING



VS-1 (VOICE SYNTHESIZER UNIT)

TALK SPEED SELECTION

Speed is factory set at "standard" talk speed. Three different speeds can be selected.

Note: When placing the jumper, solder carefully.

Speed	Std. speed	30% more than Std.	60% more than Std.
Jumper place			
1	X	X	○
2	X	X	○
3	X	○	X

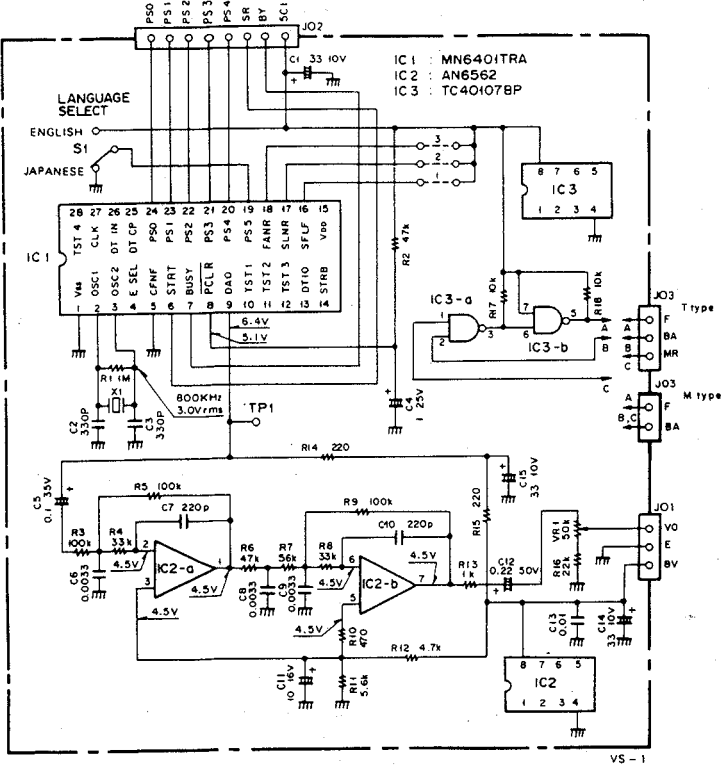
Symbol ○, denotes the place in which a jumper wire is placed.

PARTS LIST

Part No.	Re- marks	Description	Ref. No.
B50-4035-00	N	Instruction manual	
CC45SL1H331J		C 330P x 2	C2,3
CE04W1A330M	E	33 10V	C1,14,15
CE04W1C100M	E	10 16V	C11
CE04W1HR22M	E	0.22 50V	C12
CK45B1H221K		C 220P x 2	C7,10
CQ92M1H332K		ML 0.0033 x 3	C6,8,9
CS15E1E010M	T	1 25V	C4
CS15E1V0R1M	T	0.1 35V	C5
C91-0131-05		C 0.01 (SP)	C13
E40-0273-05	Δ	Mini connector 2P	M
E40-0373-05	Δ	Mini connector 3P	M
E40-0373-05	Δ	Mini connector x 2 3P	T
E40-0873-05	Δ	Mini connector 8P	
H01-4481-03	NΔ	Packing carton (inside)	M
H01-4501-03	NΔ	Packing carton (inside)	T
H25-0029-04		Protective bag x 2	
L78-0006-05	N	Ceramic OSC	X1
N89-3006-46		Tapping screw x 4	
R12-4408-05		Trim. pot. 50kΩ	VR1
S31-1411-05	N	Slide switch	S1
AN6562	N	IC	IC2
MN6401TRA	N	IC	IC1
TC40107BP	N	IC	IC3

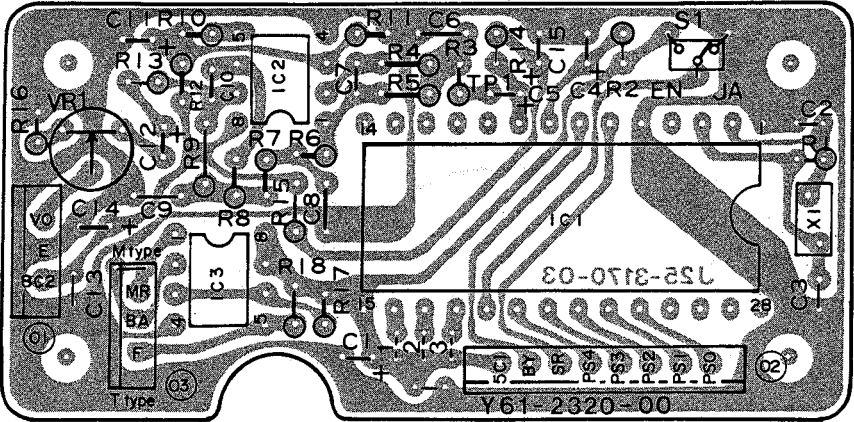
N : New parts  
Δ : Please note that these parts are sometimes not in stock and it takes much time to deliver.

SCHEMATIC DIAGRAM



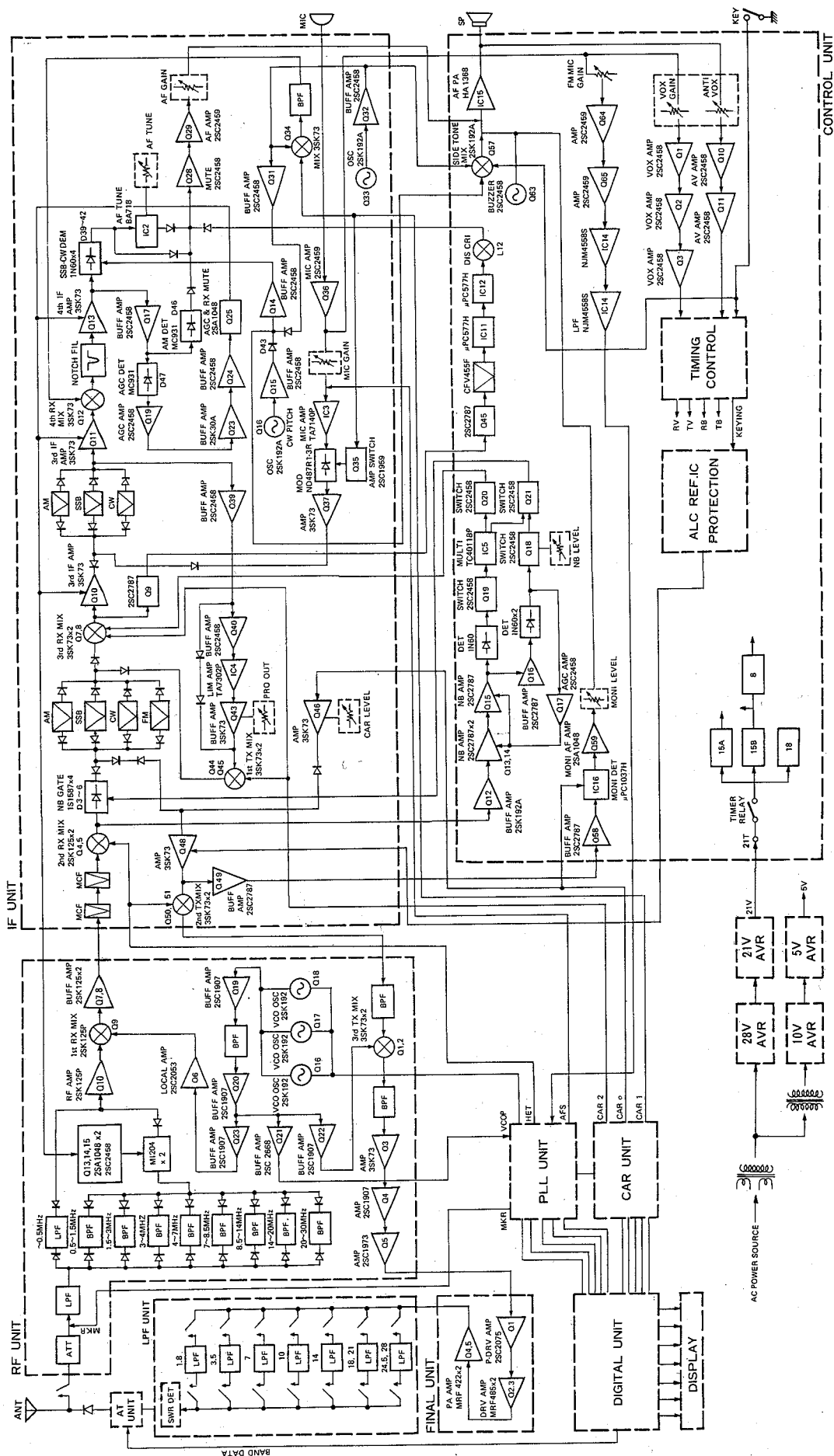
PC BOARD VIEW

Component side view





# TS-940S



# TS-940S SPECIFICATIONS

## [General]

### Transmitter Frequency :

Range .....	160m Band 1.8—2.0MHz
	80m Band 3.5—4.0MHz
	40m Band 7.0—7.3MHz
	30m Band 10.1—10.15MHz (10.0MHz WWV)
	20m Band 14.0—14.35MHz
	17m Band 18.068—18.168MHz
	15m Band 21.0—21.45MHz
	12m Band 24.89—24.99MHz
	10m Band 28.0—29.7MHz

### Receiver Frequency :

Range .....	150kHz—30MHz
Mode .....	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM), F3 (FM)
Frequency Stability .....	$\pm 10 \times 10^{-6}$ (0°C—+50°C)

Antenna Impedance with AT-940 antenna tuner .....	50 $\Omega$
	20—150 $\Omega$ (Transmission only)

Power Requirement .....	120/220/240 VAC, 50/60Hz
Power dissipation .....	Max. 510W during transmission, 80W during reception
Grounding .....	Negative
Dimensions .....	W401 x H141 x D350mm
	W409 x H154 x D420mm (Projections Inc.)
	W160.4 x H56.4 x D140 inch
	W163.6 x H61.6 x D168 inch (Projections Inc.)

Weight .....	With antenna tuner : Approx. 20kg
	Without antenna tuner : Approx. 18.5kg

## [Transmitter]

Rated Final Power Input .....	250W (160—15m bands in SSB, CW, FSK, FM)
	250W (10m Band in SSB, CW, FSK, FM)
	140W (in AM)
Modulation .....	SSB : Balanced, FM : Reactance, AM : Low level
Maximum Frequency Deviation .....	$\pm 5$ kHz
RTTY Shift .....	170Hz
Carrier Suppression .....	—40dB or less (in CW)
Unwanted Sideband Suppression .....	Better than 50dB (with 1.5kHz modulation)
Third Harmonic Modulation Distortion .....	—31dB or less (based on single tone output)
Microphone Impedance .....	500 $\Omega$ —50k $\Omega$
Frequency Response .....	400—2600Hz at —6dB in SSB

## [Receiver]

Circuitry .....	Quadruple conversion for SSB, CW, AM, FSK, Triple conversion for FM
Intermediate Frequencies .....	1st IF : 45.05MHz, 2nd IF : 8.83MHz
	3rd IF : 455kHz, 4th IF : 100kHz
Sensitivity :	
150kHz—500kHz .....	10dB S/N 10dB $\mu$ (1 $\mu$ V) or less in SSB, CW and FSK
	10dB S/N 10dB $\mu$ (10 $\mu$ V) or less
500kHz—1.8MHz .....	10dB S/N 12dB $\mu$ (4 $\mu$ V) or less in SSB, CW and FSK
	10dB S/N 30dB $\mu$ (32 $\mu$ V) or less in AM
1.8MHz—30MHz .....	10dB S/N —14dB $\mu$ (0.2 $\mu$ V) or less in SSB, CW and FSK
	10dB S/N 6dB $\mu$ (2 $\mu$ V) or less in AM
	12dB SINAD —6dB $\mu$ (0.5 $\mu$ V) or less in FM
Squelch Sensitivity .....	—10dB $\mu$ (0.32 $\mu$ V) or less
Image Ratio .....	80dB or more in 1.8—30MHz
IF Rejection .....	70dB or more in 1.8—30MHz
Selectivity :	
(SSB, CW, AM (N), FSK) .....	2.4kHz or more/—6dB, 3.6kHz or less/—60dB
(AM (W)) .....	—6kHz or more/—6dB, 18kHz or less/—50dB
(FM) .....	12kHz or more/—6dB, 24kHz or less/—60dB
Variable Range with SSB filter :	
(SSB Slope Tune) .....	High-cut : 1500Hz or more, Low-cut : 700Hz or more without SSB filter
(CW VBT) .....	600Hz—2.4kHz variable continuously
RIT/XIT Variable Range .....	$\pm 9.99$ kHz
Notch Filter Attenuation .....	40dB or more
Audio Output .....	1.5W (at 8 ohm load/10% distortion)
Audio load Impedance .....	8 ohms

**Note :** Circuits and ratings subject to change without notice due to developments in technology.

## KENWOOD CORPORATION

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 Wang Kee Building, 5th Floor, 34-37, Connaught Road, Central, Hong Kong  
**KENWOOD ELECTRONICS CANADA INC.**  
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